INFORMATION TECHNOLOGY IN EDUCATION AND EMPLOYMENT: A CRITICAL EXAMINATION OF DEVELOPMENTS IN BOTH AREAS AND THE RELATIONSHIP BETWEEN THEM

JEREMY JAMES WELLINGTON

SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (Ph.D.)

DIVISION OF EDUCATION

UNIVERSITY OF SHEFFIELD

SUBMITTED JULY 1988

FOREWORD

This thesis represents the culmination of several years work on the role of information technology in education and training and its relationship to employment. Many people have helped me in this work and I would like to pass on my thanks to all of them. In particular I would like to thank Dr. Inge Bates, Professor Neil Bolton and Dr. Peter Hannon for their comments and suggestions on the script as it developed; and Sue Cramp and Brenda Finney for producing it in its final form. I would like to thank all the schools, ITeCs, companies, organisations and libraries which have participated in the whole of this inquiry. Grateful acknowledgement is also made to the Training Commission (formerly the M.S.C.) for their generous financial support for part of the work described below. Finally, I would like to thank the TVEI unit for supplying me with figures from the TVEI database at Trent Polytechnic.

Style

The report was written using WORDWISE-PLUS on the BBC micro., and printed on a daisy wheel printer. It was not possible to use italics in the text when referring to books and documents. Hence the titles of all books and reports appear in upper case in the text and the bibliography. Three categories of heading have been used: chapter headings in upper case, bold and underlined; main headings within chapters in upper case, bold; and sub-headings in lower case, bold.

ABSTRACT

INFORMATION TECHNOLOGY IN EDUCATION AND EMPLOYMENT: A CRITICAL EXAMINATION OF DEVELOPMENTS IN BOTH AREAS AND THE RELATIONSHIP BETWEEN THEM

Jeremy James Wellington

The main aim of this thesis is to examine critically the position of information technology (IT) in both the employment and education sectors and investigate the liaison between them.

The principal focus of the thesis is a detailed enquiry into the needs of employers in the IT area, and their perceptions of education and training in relation to those needs. This enquiry utilises a range of methods: interview, questionnaire, and case study. Evidence from the employer's enquiry is compared with evidence gathered from a survey of IT education and training in secondary education and in the Information Technology Centre (ITeC) programme of the Youth Training Scheme.

As a background to the empirical enquiries and to place them in their broader context, the thesis also broadly examines four areas: the nature of information technology; its place within and effect upon employment patterns; the growth of IT in education, both as a subject in itself and as a tool; and the terms and general language used in linking education to employment.

These investigations, together with existing research and other empirical enquiries, show that the crucial skill shortages relating to information technology exist at the higher levels. It is suggested

that past attempts to relate IT education too closely to the needs of industry and "the world of work" have in fact been counter-vocational, both for the individual and for employers.

Finally, it is argued that in the context of continuing change a narrow skills-based approach to IT education and training will not serve the needs of employers and the future economy. Moreover, many of the traditional, worthwhile aims of education should remain unchanged in the future. Information technology must be used to enhance those aims, not to replace them.

CONTENTS

LIST OF TABLES

List of Tables (contd.)

List of Tables (contd.)

CHAPTER 10

CHAPTER 11

CHAPTER 12

LIST OF FIGURES

LIST OF APPENDICES

PART ONE: BACKGROUND, CONTEXT AND PREPARATORY DISCUSSION

CHAPTER 1

IT IN EDUCATION AND EMPLOYMENT: THE KEY ISSUES AND THE DESIGN OF THE INQUIRY

The aim of this chapter is to provide an introduction to the issues which form the main focus of the inquiry. The themes and issues raised will be followed up in detail in subsequent chapters, the pattern and sequence of which is also explained below.

THE VOCATIONAL SIGNIFICANCE OF COMPUTER EDUCATION

The 1981 launch of the microcomputer into all Britain's schools was accompanied by a flood of rhetoric and unreflective enthusiasm as to its vocational significance. Kenneth Baker, the new Minister for Information Technology, typified the political mood of the time. He claimed that the 'kids of today' urgently needed modern, up-to-date skills, analogous to those skills that had gained their ancestors employment:

> "...I want to try and ensure that the kids of today are trained with the skills that gave their fathers and grandfathers jobs. It's like generals fighting the battles of yesteryear ... And that is the reason why we've pushed ahead with computers into schools. I want youngsters, boys and girls leaving school at sixteen, to actually be able to operate a computer." (quoted by O'Shea & Self, 1983)

That optimism for the vocational significance of the computer permeated into many of the two million or more households which subsequently acquired computers, and may have been a major cause of the unprecedented growth of Computer Studies as an examination subject. An article in the Times Educational Supplement ('Home

Truths', 7.3.86) reported that 33 per cent of households with children now have a home computer, and welcomed this as a 'major step towards the universal computer competence required by the coming information society'. The unquestioned connection between computer education and the world of work also surfaced in the plethora of books discussing the use of computers in schools. Mullan, for example, even drew a connection between primary children's use of the micro. and the use of the computer in 'the world of work which they must experience':

> "If children meet the microcomputer in an exciting and pleasurable role in school then one could argue that there is a greater likelihood of them accepting it as an aid in the world of work which they must experience in the future." (in Garland, 1982)

The unquestioned belief in the vocational significance of information technology also deeply affected both the thinking and the publicity associated with the two key innovations in vocational education in the 1980's: the Youth Training Scheme and then the Technical and Vocational Education Initiative (TVEI).

The publicity at the initial launch of the YTS often attemped to associate the scheme with the new technologies "at the forefront of employment creation" (Finn, in Dale, 1985). This emphasis on the vocational significance of information technology (IT) has continued in the same vein with the advent of the two year YTS. The televised publicity drive for the two-year scheme even includes an employee of the world's largest computer firm beckoning a "typical youth" into their organisation.

Similarly, the drive behind TVEI depended to a large extent on its perceived links to new technology and in particular information technology. One of the key factors behind the initiative was the continuing emphasis on "high-tech". industry in the early 1980's. This in turn led to the belief that future employment prospects would be greatest in IT based industry and commerce(1).

This is a belief which is subject to thorough and critical investigation in the chapters that follow, both by considering existing information and literature and by presenting new data on the current links between education and employment in IT. The links between information technology in education and information technology in employment have never been fully and critically examined. There has simply been an implicit and unquestioned assumption in the minds of many people (parents, children, teachers and policy-makers) and perhaps an ideological belief from politicians, that IT education at any level will make its recipients more employable. These beliefs have provided the main impetus for much of the information technology in schools, colleges and of course the ITeCs (Information Technology Centres). The purposes of an ITeC have been described in Smith (1985). Their aim is:

> "... to provide young people with the NEW SKILLS necessary for Britain to take a leading part in the technology revolution."

Similar arguments for IT education were expressed in the Alvey Report of 1982, A PROGRAMME FOR ADVANCED INFORMATION TECHNOLOGY:

> "... a substantial programme is vital to generate more human resources to develop IT products and to apply them in all areas of industry. The supply of skilled manpower in this respect is totally inadequate for current and future needs."

But what are the "skills" needed for Britain's "technological revolution", and at which level are they required? How can Britain's education and training systems best provide the human resources needed to develop both our IT industry and the use of IT in industry? These questions are central to the inquiry which follows. More fundamentally, should the education system be expected to fulfil a role of this nature? Can education serve the function of developing industry and the economy?(2).

THE TERM "INFORMATION TECHNOLOGY"

It is appropriate at this stage to make a brief, preliminary examination of the term 'information technology' since it is used so commonly throughout the pages which follow. Interpretations of the term vary widely, as the empirical work discussed later exhibited only too clearly - indeed it could be argued that one of the contributions of the empirical work was to reveal the conceptual difficulties involved(3). The aim of much of the fieldwork was to examine the key concepts and categories emerging in this area - notions such as skills, skill shortages, education and training, vocationalism and so on. The term information technology however is singled out for prior analysis.

The language of employers

Wittgenstein's discussion of the use of language in his later work, in particular PHILOSOPHICAL INVESTIGATIONS (1963), is often paraphrased or summarised by the slogan "the meaning of a word is its use". An important way of probing into the meaning of a term is to discover the ways in which people actually use it. This was therefore one of the aims of the exploratory research into employers' perceived requirements of IT education. That research is described in detail in chapter 8, but small elements of it are worth introducing here.

In the exploratory interviews with employers described later, the interviewee was asked:

> "At which levels do you recruit people in the information technology area of your company?"

The response of several employers was to question immediately (though perhaps somewhat rhetorically) the meaning of the term. This inevitably led to some discussion of the notion of IT and, later in the interview, of the notion of an IT skill. These discussions were of great value in clarifying the meaning of the terms being used within that particular interview.

My initial reaction during the exploratory research was to abandon the use of the term IT during interviews. It seemed that it was not part of the common parlance of employers. However, the uncertainty over the term did have two unexpected but valuable outcomes.

Firstly it did stimulate discussion on the term itself, on the various people who have used the term ("didn't we have a Minister for Information Technology a few years ago?": GEC recruiting manager, 6.2.86), and on the reasons for using it now. One of my first reactions was to ask if IT is not a term used by employers then should it be used in empirical work and more importantly should it be used in describing courses, curricula, and educational aims? (as for example in the variety of documents and schemes discussed in chapter 4.) However the very fact that it was seen as problematic by others did, as mentioned above, improve and stimulate discussion. Secondly, it soon became clear that the term IT was worth continuing with during interviews, because it is not the wrong term - it is simply operating at too high a categorial level in a discussion on the requirements of employers. Employers were inclined not to use it because it is at too high a level of generality and abstraction in a discussion of particular needs, expectations and requirements. One is reminded here of Gilbert Ryle's notion of a category mistake (Ryle, 1949). He tells the story of a foreign visitor being shown round the various colleges of the University of Oxford. The visitor is very impressed with what he sees, but at the end of the long tour he asks of his host, "now could I see the university?". The visitor is making what Ryle calls a category mistake. In this case he is confusing a term operating at one level (college) with a term operating at another (university). A very similar confusion was occurring in my initial interviews with employers. I was expecting them to operate with a term at a high level of generality (IT), when they wished to use terms and descriptors at a far more concrete level. Individual employers tended therefore to translate the term into its concrete components. Examples, which will be elaborated upon later in reporting the empirical work, included programming, systems analysis, software engineering, control engineering, and so on.

For the two above reasons i.e. that the term IT stimulated discussion, and that each employer tended to produce their own concrete translation of the term's meaning, the use of the term "information technology" was retained for this inquiry. It is, I suggest, a valuable term provided one realises that it is at a high level of generality and will often need to be "translated down" into its concrete components. The exploratory research undoubtedly helped to clarify this point and therefore provided a useful lead in to the further analysis of the notion of "information technology" and its sub-terms which follows.

TOWARDS A WORKING DEFINITION OF IT

Although the term 'information technology' is now in common use it is in fact a relatively recent addition to the language. For example, the term has only been used in the American ERIC (Education Research Information Center) database since 1986 and therefore any search of the literature on IT in education will need to use related keywords in order to reveal research before that time. The other practical problem, as mentioned earlier, with a new term is that in practice it may mean all things to all people (as indeed may an old term, for different reasons). The term IT has its counterparts in other languages such as French ('informatique') and Russian ('informatika'). The presence in English of the term 'technology' is perhaps the cause of some confusion since the term implies 'the practice of an applied science' (Oxford English Dictionary) which in turn seems to apply a recognised 'information science'. However this line of searching for meaning is unsatisfactory (as Zorkoczy, 1985, points out) because of the very restricted nature of the term 'information science'. Whatever IT is, it is more than the application of 'information science'. Indeed many would now argue that IT involves the arts and humanities as much as any branch of science. In looking for the "parentage" of the term therefore we must look not only to the science of electronic systems and computer science, in addition to information science (Zorkoczy, 1985), but also to the major contribution of the Arts & Humanities to IT in terms of handling, presenting, designing and communicating information.

An attempt to make a watertight definition of information technology is therefore unlikely to be wholly successful due to two factors: firstly, its extremely mixed parentage and secondly, its common usage as an umbrella term to embrace a number of activities and disciplines. One attempt at a working definition which I would suggest at this stage is that information technology involves any activity connected with the collection, processing, communication and presentation of information using electronic systems.

The drawback of this definition, it might be argued, is that it includes a wide range of activities which themselves belong to established disciplines and therefore does not attempt to set up (or reify) IT as a discipline in its own right. However, my intention is not to deny the belief or hope held by some that the introduction of a new term 'information technology' will enable IT to establish itself in future as a new discipline in which the principles, practice and terminology of information handling are dealt with "on a unified systematic basis" (Zorkoczy, 1985). At present, though, IT is not yet a unified discipline in the same way as (say) Physics or Psychology with its own research traditions, working practices, methodologies and paradigms. Perhaps it may evolve into one in the same way as scientific disciplines have evolved from "pre-science" into established sciences with their own communities, traditions, frameworks and networks (as discussed by Kuhn, 1970), but this remains to be seen.

My own view is that the term 'information technology' will, and should, remain an umbrella term embracing a variety of disciplines and activities. This is certainly the way in which it is used by employers (described fully in subsequent chapters) who tend to translate it into more concrete reality in discussion. Zorkoczy (1985) takes a similar view that the meaning of the term 'IT' can be clarified by giving examples and describing it in terms of its 'constituent parts'. These constituents will include activities at many different levels, in both education and employment. IT may include word-processing, desk-top publishing, and the use of databases and spreadsheets. It may also include artificial intelligence, chip manufacture, telecommunications, robotics, software engineering and systems analysis at a higher level of generality and expertise. New branches of information technology will emerge in the future as computing and communication systems develop. Perhaps the discussion should be left at this point by offering the working definition given earlier as a starting point, and suggesting that a more satisfactory definition of IT may be achieved by developing what J.S. Mill called an extensional definition (as opposed to an intensional one, which attempts to set out boundaries, conditions and essential meanings: Mill, 1961). An extensional definition of IT will include its constituent parts, at different levels of generality and expertise, as they emerge in documents and discussions. This extensional definition of information technology, in which the term is defined by the range of "objects" to which it applies, will emerge in subsequent chapters.

THE DEVELOPMENT OF THE INQUIRY

Starting Points

In a venture of this nature, which attempts to provide an overview of such a wide field, it is necessary to decide on suitable starting points. The initial aim was to locate both methods and findings in the context of previous work published and unpublished. This necessitated a survey of the extensive literature in the field of education and training for employment and for new technologies, which needed to be continually updated. A selection of literature in this area (as current as possible) is given in the bibliography and, although not all of that literature is considered in detail below it helped to provide a valuable backcloth to the work (an Annotated Bibliography summarising pertinent points in the available literature on IT in education and employment is referenced below: Wellington, 1988).

In addition, outlining the context and framework of the project also involved contacting organisations and institutes involved in information technology, whose work in some cases had not been widely published or disseminated. (A list of these organisations is given in Appendix 1).

Preliminary searches indicated that although previous work had been carried out on both education and employment in information technology they had largely been treated as separate areas of inquiry. No published studies have attempted to analyse the links between education and employment in IT and examine the match or mis-match between them. For example, a small number of empirical studies have now been published which examine the needs of industry for IT personnel both now and in the future (for example, Glyn-Jones, 1984; Connor and Pearson, 1986). Similarly, studies have been made of the use of IT in education and training (for example DES, 1986; Gilbert, 1985; Bleach, 1986.) although it must be said that these studies have concentrated on one aspect of education only and have not considered any overall strategy from primary to tertiary levels. However, empirical work in the past has made little attempt to relate the needs of employers to current provision of education and training in IT or vice versa.

One exception, it might be argued, is provided by a rarely cited but important compilation of evidence provided for a Select Committee on Science and Technology of the House of Lords in 1984.

The committee collected evidence (both oral and written) in the form of memoranda from a wide range of individuals and companies involved in education, training and employment for new technology. Many of those memoranda welcomed the new ITeCs (Information Technology Centres) and applauded the (then new) TVEI as a "good thing". Other pieces of evidence showed concern at the output (in quality and quantity) from further and higher education in the broad field of IT. These three areas - education, training and their relation to employment - form the key areas of concern for this inquiry, and thus the three volumes of The House of Lords Select Committee Report, EDUCATION AND TRAINING FOR NEW TECHNOLOGIES, (House of Lords, 1984), provide a valuable reference point.

Initial decisions on aims and strategies

In the light of the preliminary considerations outlined above the following general aims were established to form a framework for the investigation:

* to determine the needs and requirements of a wide range of employers in the area of information technology.
* to compare the range of IT skills and competencies required by employers with the current provision of education and training at school level and above.

* to suggest a more coherent and responsive approach to information technology education and training in the light of the study of IT in education and employment.

The path of the inquiry: short narrative

My initial interest in the questions outlined above led me to carry out exploratory work into the "needs of employers" in IT, with the aid of a small grant from the University of Sheffield Research Fund. This exploratory work, involving a study of existing work in this area coupled with initial interviews with a range of employers, pointed to certain questions which needed to be explored further (details of the exploratory work and the issues raised by it are given in Chapter 8). It also pointed to the methods of inquiry which should be examined for their appropriateness in achieving an accurate grasp of the key issues (detailed consideration of methods is again postponed - see Chapters 7 & 8).

Following the exploratory work, a submission was made to the Manpower Services Commission (the MSC, as it was then) for a much larger grant to explore the issues in detail and also to provide TVEI related in-service training (TRIST) for three teachers in the area of industry-education links in IT. In 1986 a substantial grant was received from the MSC under the TRIST initiative - part of the work described below was carried out with the financial support from that grant which enabled a generous travel allowance to be combined with my own sabbatical leave. The help of the MSC is therefore gratefully acknowledged.

Finally, the ultimate aspects of the inquiry were made possible by my partial secondment to a newly created Institute for Information Technology in the University of Sheffield, where I took the post of Industrial Liaison Officer (ILO) in late 1986. In the role of ILO I was able to continue to interview employers and also begin to collect material for the case-studies described later.

THE STRUCTURE OF THE INQUIRY AND RESEARCH DESIGN

The "traditional" structure of an inquiry or a research project is often seen as a linear one (as caricatured by Burgess, 1985, for example). A full analysis of the literature is carried out (the "pre-fieldwork phase") followed by the fieldwork itself, with an analysis of results (or data) followed by the write-up. Whether or not a truly linear model of this kind has in fact ever been followed in practice or is merely an idealised, post-hoc view of research is not the issue here (see Medawar, 1963) - my argument is that a model of this kind is totally inappropriate for a study involving a steadily changing phenomenon of any kind, let alone the links between two independently varying areas such as education and employment. The notion that previous work is reviewed, the original fieldwork is carried out, then results analysed and conclusions drawn in a sequential way no longer holds water in the context of steady change. The activities, including writing up and forming conclusions, must be carried out in parallel. The process is therefore a cyclical rather than a linear one - this has been a key feature of the inquiry which follows.

In my view, this notion has been best expressed in discussions of ethnography as a method of inquiry (the seminal work being Glaser & Strauss, 1967). Although not pretending that the study below could be described as an "ethnography" in any way, some of the fundamental features of ethnography and its principles have been deliberately adopted in its conduct. Those principles are expressed in a variety of ways by the numerous commentators on ethnography listed in the Bibliography (for example, Fetterman (1984), Turkle (1984), Hammersley and Atkinson (1983), Woods (1985)). The key principles from the huge body of literature available which are adopted in the inquiries that follows can be singled out as follows, and are elaborated upon in Chapter 7.

Firstly, the importance of understanding the perspectives of the people under study is paramount. This necessitates, amongst other things, observing their everyday activities in context (be that the school, training centre, or other workplace). This may involve one form of "participant observation" although there are important variations of this approach between complete participant, at the one extreme, and complete observer at the other (Hammersley and Atkinson, 1985). This implies a mixture of methods (see Chapter 7) and an openness or general alertness to issues which are of prior concern, as well as those which emerge during the inquiry.

A concern for perspectives and an alertness imply that the inquiry cannot be fully designed or specified in advance i.e. in the pre-fieldwork phase. This point is reinforced, as mentioned earlier, by the fact that a rapidly changing area of inquiry will constantly throw up new literature and new perspectives on the fieldwork. In other words, research is designed and re-designed "as you go along. Research design should be a reflexive process operating throughout every stage of a project." (Hammersley and Atkinson, 1985, p. 28).

Many of the problems identified by ethnographers also emerged in the inquiries described below. Access emerged as a key issue. This included access to the necessary data, the "important" people, the right contexts (in time and space) and the key informants in a company, school, or other institution. In addition to access, personal relationships were vitally important. This included relationships with individuals, with groups, with people at different levels in a hierarchy, or a general relationship with the organisation studied e.g. a well-known manufacturer or a retailer. Their impressions and perceptions of the "outsider" carrying out an inquiry were as important in this study as they are in a genuine ethnography. Personal appearance, dress, technical knowledge, educational background, and natural conversation thus become as important in the inquirer as in the objects of the inquiry. Subject and object were of equal importance, as indeed modern physics now considers the measuring device to be as vital as the phenomenon itself being measured (Capra, 1983).

In a sense, therefore, certain aspects of the inquiry inolved an 'educationalist' studying industry and employment much as an anthropologist studies a different culture - and thus certain principles of ethnography were particularly appropriate. Indeed the two areas, education and employment, could be labelled as two "cultures".

THE STRUCTURING OF THE CHAPTERS

Given the previous discussion on the cyclical and reflexive ('reflexive': 'capable of bending or turning back; turned or directed back upon the mind itself', Shorter Oxford English Dictionary) nature of the whole inquiry, the seemingly linear layout of the chapters below is a betrayal of reality. This is much as Medawar (1963) claimed of scientific research, that the neat, orderly structure of scientific papers is a "fraud", hiding the messy reality beneath them. Nevertheless the chapters are ordered in a fairly traditional way beginning with the background and context to the key issues, followed by the empirical inquiries and ending with analysis and discussion. However it is hoped that the principle that analysis of data occurs at all stages and is a continuous process is upheld and is visible.

Part One provides the background to the later inquiries and outlines the education and employment context in which they are located.

Chapter 2 sketches the employment context by considering employment patterns, and particularly the problem of identifying IT within employment. An initial discussion is made in this chapter on the implications of these patterns for education and training - a discussion which is followed up in the final chapters. Chapter 3 examines the key concepts involved in relating education to employment generally, and more particularly in the area of information technology. Again, preparatory discussion is made of the implications of new technology for vocational education and the language used to describe it. Chapter 4 then provides an overview of recent trends in informaton technology in education.

The empirical work on education and training is described subsequently in Chapters 5 and 6. Chapter 5 reports on the work on IT education in secondary schools which involved a mixture of methods - interview, observation and electronic survey. Chapter 6 examines a contrasting approach to IT preparation - the training provided as part of the Youth Training Scheme by the Information Technology Centre (ITeC programme). The similarities and the contrasts between the approaches reported in Chapters 5 and 6 provides much of the substance for the later discussion of approaches to IT education and training in concluding chapters.

The main empirical inquiry, into the field of employment in information technology, is introduced, reported and initially analysed in Chapters 7 to 11. Chapter 7 outlines the approach adopted and the methods used in part of the inquiry. The exploratory work is described in Chapter 8 which led on to the national surveys of employers' needs described in Chapters 9 and 10. The detailed case-studies of five employing organisations are introduced, reported and then analysed in Chapter 11.

Finally, Chapter 12 attempts to draw the various facets of the inquiry together and offers conclusions related to previous published work in the area. This chapter puts forward positive recommendations for a future approach to vocational education in the "information age", and suggests lines for further research in this rapidly changing area.

CHAPTER ONE: NOTES

(1) Dale (1985) provides a full discussion of the motives behind TVEI.

(2) A question asked most publicly by Berg (1970), in his cleverly titled Education and Jobs: The Great Training Robbery (Penguin).

(3) Gilroy (1983) provides an educationalist's perspective on the importance of empirical work in clarifying concepts.

(4) Decisions had to be made on the limits and scope of the empirical inquiry into education and training, since it was impossible to cover the whole field in any depth. The results of the inquiries discussed later therefore relate only to the study of secondary school education and to one aspect of the Youth Training Scheme i.e. the ITeC programme. Due to limitations on time and available resources no empirical study could be made of other developments in non-advanced further education.(It is argued later that this area merits a separate study in its own right.) In considering the generalisations made from the study and the concluding discussion in Chapter 12 therefore, this limitation should be borne in mind.

CHAPTER 2

PREPARING FOR THE INFORMATION SOCIETY?: EMPLOYMENT PATTERNS AND THE GOALS OF EDUCATION

Links between education and employment are not new, although they appear to grow stronger in a period of rising unemployment (Watts, 1983). This chapter analyses the way in which patterns of employment have evolved in recent years by examining data from the Department of Employment. The implications of these patterns for education, initiatives involving information technology, and vocational training in IT for the future, are considered in the light of this analysis.

The aim of this chapter is therefore to consider current patterns and recent trends in employment and to discuss their relationship to the goals of education. The chapter is divided into four parts. The first section sketches the background to the issue by considering the bond between education and employment, certain models used to explain unemployment and the effect of these models on educational policy and planning. Second, a closer look is taken at the structural changes which have occurred in employment across all sectors of industry and commerce by examining the data available from the Department of Employment. Third, the notion that a new sector of employment is forming, the 'information sector', is examined by considering the data and the contrast between popular forecasters of the future (such as Stonier and Toffler) and the critical approaches of Gershuny and others. Finally the implications of changing employment patterns for

IT education both now and in the future are discussed in the concluding section.

BACKGROUND: EDUCATION-EMPLOYMENT LINKS

The Tightening Bond

The term now widely used to refer to the strengthening link between education and employment - the "tightening bond" - was first coined by Marshall in 1963. More recently a summary of the issue by Watts (1983) discusses the influence of rapidly rising unemployment on this bond (figure 1 shows the rise of unemployment up to the present day).

The impact of unemployment on education can be divided into four stages:

1. The implicit promise in schooling (i.e. 'work hard at school to get a job after it') is undermined.
2. The direction and traditional function of schooling and education is questioned.
3. Education, training and 'pre-vocationl education' are increasingly seen as an instrument to respond to youth unemployment.
4. The bonds between education and employment are tightened.(1)

The latter stage is perhaps the irony in the influence of rising unemployment on education. It seems a paradox that the main effect of unemployment has been to strengthen the bonds between education and employment, and lead to the growth of vocational education. At the same time, there has been an increased emphasis, and belief in, the utility of education i.e. the view that education should be useful and geared towards jobs and employment, rather than be seen as an end or a good-in-itself. It is at the growing emphasis on the education - employment interface that this chapter is aimed. It may be argued that education should not be in any way concerned with trends in employment - this argument is considered in a later chapter. Given that the two are in fact commonly linked, to which models of employment (and unemployment) should education and training be related?

A recurring debate

It is worth pointing out that growing discontent with the education system in a time of rising unemployment is not new. In 1923 the Malcolm Committee report EDUCATION AND INDUSTRY attracted numerous complaints from employers who felt that school standards in the basic skills were too low. The concern to make education more relevant to employment and the needs of industry is, as Reeder (1981) points out, a "recurring debate".

Nor, as people are well aware, is concern confined to pupils, parents and employers. Leading politicians of both major parties, at either end of the last ten years, have become involved in the debate. The Ruskin College Speech of James Callaghan in 1976 contained an attack on informal, modern teaching methods, a 'concern for standards' and a criticism of the poor relationship between schools and industry. In short, Callaghan questioned the very function of schooling by suggesting that schools were not providing the necessary skills. Two quotes from the Ruskin College speech serve to illustrate this point:

> "I am concerned to find complaints from industry that new recruits from the schools sometimes do not have the basic tools to do the job;"

and later:

> "There is no virtue in producing socially well adjusted members of society who are unemployed because they do not have the skills."(2)

Two points of major importance emerge from this speech which have had a potent (though often tacit) influence on discussions of education ever since. Callaghan's first point, by implication, is that one of the key factors in the rise of unemployment is the shortage of relevant skills. This is often termed the 'skills-deficit model' of unemployment. It is a model which is often adopted implicitly, and sometimes explicitly, by the government White Papers discussed in the next section. In adopting this model Callaghan was suggesting that one of the key functions of education is as an instrument to provide 'necessary skills' and thereby reduce youth unemployment. The second implication which has quietly influenced the development of pre-vocational education ever since, is that a set of 'relevant' or 'necessary' skills exist which (if acquired) would make students more employable and in Callaghan's words, provide the 'basic tools to do the job'. Since that time the language of skills, skill acquisition, and training for skills has increasingly permeated discussion of education and training. As Hart (1978) points out the word skills has become appended to virtually every educational aim. (Chapter 3 provides a full discussion). Callaghan made no attempt to outline what the necessary or relevant skills are - he simply implied that they exist. One of the aims of this chapter is to examine critically the Callaghan notion of relevance by studying employment patterns and their possible relation to the goals of education.

Models of unemployment and their effects on education

The actual growth in, and the consequent fear of, unemployment have given rise (rightly or wrongly) to a concern for standards and pleas for a return to basic skills. This concern is bound up with the belief in two models of the causes of unemployment which can be called the skills-deficit and the cyclical models. Both models are present in the two key White Papers which lent impulse to the present momentum of vocational education.

The 1981 White Paper, A NEW TRAINING INITIATIVE, contains three key paragraphs revealing the two implicit models of the causes of unemployment and its relation to education:

> 'The skill shortages which have held back our economic progress in the past could reappear when the economy recovers.' (Paragraph 48)

> 'For the immediate future the Government sees an increase of public expenditure on this scale as the only way of plugging the gap in the training provision required if we are to be read to meet the skill needs of the economy as trading conditions improve and to offer adequate opportunities to the current generation of young people.' (Paragraph 58)

> 'For many years now our system of training has failed to produce the numbers of skilled people required by a modern competitive economy.' (Paragraph 61)

The skills-deficit model comes through strongly in all three paragraphs. The second model of unemployment (the 'cyclical model') suggests that an upturn of the economy is 'just around the corner' and that unemployment will decrease as trading conditions and the economy recover. The reliance of the 1981 White Paper on the skills-deficit and cyclical models of unemployment clearly determines its views on education and training. This comes through most clearly in its references to "skill needs", "system of training", "skill shortages", and the suggestion that unemployment can be tackled by tightening the bonds between education and employment - these notions are examined in Chapter 3.

Unemployment continued to rise steadily after 1981 yet three years later the 1984 White Paper 'Training for Jobs' seemed to be offering similar explanations of unemployment and the failure of education. The skills-deficit model of unemployment comes through once more:

> 'It (vocational education) will enable many more people to be trained and improve their prospects of employment by placing greater emphasis on equipping them with skills that are currently required.' (Paragraph 41)

However, as in the 1981 paper, no attempt is made to investigate or even clarify the notion of 'skills that are currently required'. References are again made to 'skill shortages holding us back' but no suggestion is made as to which skills are in short supply. Some mention is made in the following paragraph of specific skills: literacy, numeracy and communication skills are listed. However, these could hardly be said to lie outside the realms of general education. Nowhere in the paper is an attempt made to specify the skills required for a truly vocational education, or the skills which 'employers will require in the future'.

The vocational significance of IT skills

One of the effects of the skills-deficit model of unemployment as with Callaghan's speech, has been to increase the incidence of the language of skills in discussions of education and training. This has been particularly true in discussions of the role of education in relation to new technology as Chapter 3 discusses in full. A clear example can be found in the 1984 White Paper:

> 'The main objective of this strategy (training programmes) is to secure an adequate supply of people with up-to-date skills to meet the demands of new technologies upon which economic growth must be based.' (Paragraph 39)

The thinking implicit in this paragraph has underpinned the Technical and Vocational Education Initiative (TVEI) and the Youth Training Scheme (YTS). The first crucial point in the above paragraph is the suggestion that an "adequate supply of people with up-to-date skills" is needed to support new technology. This type of thinking has led to the implicit belief in the vocational significance of information technology already mentioned, which has deeply affected both the planning and the publicity associated with TVEI and YTS. Computer literacy, or Information Technology (IT) literacy, was given a key position in YTS with its identification as one of the "Core Skills" in the programme. All YTS trainees therefore receive some grounding in IT literacy although the interpretation of that phrase appears to vary widely (Bailey, 1986). In addition, a large number of young people (approximately 6,000) on YTS are engaged in training at the Information Technology Centres (ITeCs) around the country. The validity of this thinking will be examined fully in the light of the empirical inquiries described later.

The second crucial point in the above statement is the suggestion that "economic growth" will be based on "the demands of new technologies". This may well prove to be true, but does it mean that growth in employment and educational planning will be directly related to new technology?

This question needs to be examined from two perspectives. Firstly, will the predicted economic growth as a result of new technology actually increase the numbers in employment who are directly involved with new technology, either in producing it or using it. Economic growth through new technology may actually increase the numbers in employment overall but these employees may not be directly involved in either using or producing new technology. They may, for example, be employed in an expanding service sector made possible only by a lean, efficient and technologically advanced manufacturing sector. It may then be the case that only a small, highly educated and technologically skilled elite will be directly involved in new technology. Economic growth will thus depend significantly on the skills and education of this technological elite. This leads to the second perspective on the above question: the educational viewpoint. If, in an advanced industrial society, the key personnel required to sustain and develop new technology are small in number and educated to a high level, the implications for educational planning are profound. Should the education system be geared towards producing this technological elite on which economic growth and therefore general employment will depend? If so, what are the implications for a common curriculum and indeed for comprehensive education generally?

An attempt is made to throw some initial light on these questions in the following sections by considering recent employment patterns and speculating on their future implications for education and training.

A CLOSER LOOK AT CHANGING EMPLOYMENT PATTERNS

The Standard Industrial Classification

The purpose of this section of the paper is to analyse in detail changing patterns of employment by considering the ten divisions of the Standard Industrial Classification (SIC) used in Britain since 1980. Statistics produced by the Department of Employment are used to exhibit and discuss the changes which have taken place in different sectors of industry, commerce and the services. Before presenting this data, however, it is worth pointing out, firstly, that other classifications of employment are of course available; and secondly that the crude distinctions between manufacturing and services or between primary, secondary and tertiary industry often associated with the SIC can disguise a more complex reality.

Gershuny (1978) distinguishes between two types of employment classification - the first being employment as classified by industrial sector, the second being an occupational classification which "looks only to the nature of the job" (Gershuny, page 59). The distinction is expressed by the Office of Population Censuses and Surveys (OPCS, 1980) as follows:

> ".... the industrial classification differs essentially from the occupational in that the latter takes account only of the nature of the work performed by the individual, while the former has regard only to the nature of the service or product to which his labour contributes."

The industrial classification has been chosen in this chapter as one means (though not the only one) of relating employment patterns to the goals of education. Its drawback, pointed out above, is that it takes little account of "the nature of the work performed by the individual" and therefore it should not be seen as the only classification for discussing the goals of education. However, the industrial classification of employment has been used throughout (and more immediately in Tables 1 - 5 and figures 2 - 4) for three reasons. Firstly the data are readily available from, and regularly revised and updated by, the Department of Employment; secondly, partly as a result of the first point, recent trends in employment in ten separate sectors of employment can be analysed, and within the limitations of this classification, used as an accessible framework for discussing education-industry links in the future as new figures constantly come in (i.e. the patterns and the arguments presented below can be readily monitored and revised by the non-expert); thirdly, the SIC allows some insight into the position of information technology in employment (a point discussed later, alongside its limitations).

Before looking at the SIC figures a word of caution is needed on their division of industry into sectors. A full critique of the impossibility of fully separating manufacturing from service industries is provided by Gershuny, 1978, in particular in Chapter 5. He argues that "service workers" are often engaged indirectly in the production of goods although they may be distant from actual material production. He also points out that the direct consumption of services by people has not actually increased at the same rate as the numbers employed in the service sector. Gershuny suggested that we may be moving towards a self-service economy (rather than a service economy) as more people buy goods to carry out services for them. Gershuny's arguments cannot be fully considered here - however they do point to the need for caution in studying the data about to be presented. (Gershuny's later work on the information sector is considered shortly). Caution is likewise urged by Kumar (1978) who mounts a similar critique to that of Gershuny of the view that society is moving towards a service economy or a post-industrial era. (Woodward, 1980, is also critical of the notion of post-industrial society).

Employment trends using the Industrial Classification

Primary Industry: Table 1 shows the ten divisions of the Standard Industrial Classification. Divisions 0 and 1 (the so-called primary sector) involve agriculture, forestry, fishing, coal mining, oil refining, gas and water supply and nuclear fuels. The numbers employed in these two sectors are given in Table 2 and shown graphically in figure 2. As that table shows, the agricultural sector is now a relatively tiny employer accounting for only 1.6% of the total workforce in February 1987.

Manufacturing: Divisions 2 to 4 represent the manufacturing industries. At present, as Table 2 indicates, those divisions account for just under 25% of the total numbers employed. In other words one worker in four is involved directly in manufacturing. Stonier claims (Stonier, 1983) that by the end of this century only one worker in ten will be employed in producing the goods needed for the other nine. His claim is worth examining in the light of available data because this is the very sector which most people conceive of when they consider "industry" i.e. production and manufacturing.

Data on the relative decline of numbers employed in manufacturing compared with non-manufacturing are displayed in figure 3. The graph shows that the numbers employed in manufacturing experienced a sharp decline from 1979 to 1983, of nearly two million people. However, this decline has levelled off in recent years to the present figure of around five million (see Table 2). For Stonier's prediction to come true this number would have to be more than halved in the next fourteen years. If this did occur the implications for the education-employment interface would be enormous. For example, the importance of preparing school pupils for working life in the manufacturing sector would carry little more weight than the importance of preparing them for a life in fishing, agriculture or energy supply.

One important fact lends credence to Stonier's prediction: automation and robotization are nowhere near as advanced in Britain as they are in certain other Western European countries, let alone Japan (Morishima, 1985, and Social Europe, Supplement 1/86 provide an analysis of Britain's lag behind Japan, Sweden and West Germany in automation and robotization). The effect of robotics and microelectronics on Britain's working patterns clearly has not yet been fully realised. A recent report from the Policy Studies Institute (Northcott, 1986) suggested that 87,000 jobs in manufacturing had been lost in a two year period as a result of the use of micro-electronics. The rate of job losses is likely to spread further, as advanced systems continue to enter manufacturing. The implications for vocational education of these changes in both manufacturing techniques and numbers employed is certain to be profound but, perhaps more importantly, difficult to predict.

Construction: The construction industry, Division 5 sits somewhat uneasily at the centre of the SIC. In Department of Employment figures this sector is not included in manufacturing though some may consider this debatable. Construction now accounts for just under 5% of the working population with less than a million workers. The number of employees in this sector has declined by almost 6% in only the last four years. Again, future changes in this sector must surely be monitored in discussing the aims of vocational education, so much of which is related to building and construction.

The "tertiary sector": The final four sectors of the SIC are often lumped together and referred to as the tertiary sector. As suggested earlier, this combination may not be helpful in considering links between education and employment. Each of the four sectors is considered separately here.

Table 2 shows that the total numbers employed in the four sectors now account for no less than 67% of Britain's working population. In other words, two workers in every three are employed in the tertiary sector. Division 9 alone, "Other Services", account for around one worker in three. This division includes public administration, defence, the fire and police services, education, medicine and recreation. However, it is Division 8 which is now the most rapidly expanding category of employment of any of the ten sectors. This Division includes banking, finance, insurance, advertising and agencies of all kinds. The numbers employed in this category have grown by a remarkable 25.2% in the last four years, and now make up one tenth of the total working population. If this trend continues how long will it be before it accounts for more than the numbers employed in manufacturing? Simple linear extrapolation is, of course, a highly questionable procedure. However, by extrapolating from my own graphs which (to reduce complexity) are not displayed here, it seems possible that Division 8 may overtake the major manufacturing sector, Division 3, as an employer before the end of this decade. It already exceeds both Division 2 and Division 4.

Of the four tertiary sectors, Division 6 which includes distribution, hotels, catering and repairs is the second largest sector in the ten SIC divisions and also the second most rapidly growing. On its own it accounts for almost as many employees as all of the manufacturing sectors and seems likely to equal them by the end of the decade. It is only Division 7 in the tertiary sector which has actually lost employees in the last four years. This Division includes rail, air, sea and road transport, and postal and telecommunication services.

The recent trends in employment in all of the ten sectors are shown in Table 3 and displayed graphically in figure 4. The graph shows clearly the marked decline in all of the primary and secondary sectors of employment since 1982, alongside the increase in tertiary divisions with the sole exception of Transport and Communication (Division 7).

Before discussing the implications of these employment trends for the goals of education one category of employment which is not easily extracted from the Standard Industrial Classification, and yet (as discussed already) has had tremendous influence on education policy and ideology, will be considered. That is the category known as information technology.

INFORMATION TECHNOLOGY IN EMPLOYMENT

Preparing for the "Information Society"

It has become almost a cliche to suggest that education and training should prepare "young people for the Information Technology Society which awaits them in adult life" (Chapman, 1986). Such thinking has surfaced in writing so frequently in documents on initiatives, on youth training, in discussions of microelectronics and technology education, and even in school booklets that it would be unfair to single out a specific reference to use as an Aunt Sally. The purpose of this section is to begin to examine the general thinking and assumptions behind such statements.

The assumption behind the view that one of the new and vital goals of vocational education should be to provide pupils with skills in information technology (IT) for adult life can be broken down into three parts. Firstly it involves the belief that "IT skills" are a new and distinct category in themselves.

My aim throughout is to seriously question this belief. I would suggest initially that skills involved in IT are a subset of the general skills involved in handling, processing and communicating information whatever the technology rather than a new category in themselves. These skills are known simply as literacy and numeracy. IT skills are logically secondary (i.e. subsumed under) these more general abilities. This point of logic is strongly supported by empirical evidence from the employers survey (see later chapters), many of whom considered literacy and numeracy to be the most important prerequisites for jobs involving IT.

Secondly, there is an important debate as to whether or not information technology will assume the importance and omnipresence in adult life often predicted for it. Two important critics of that view are Weizenbaum (1983) and Aleksander (1986). Both suggest that, although IT will pervade modern life, it will become increasingly easier to use as technology develops and will in an important sense become less "visible".

In other words, the ability to use information technology will be easier to acquire as the technology improves and (to use the jargon) becomes more "user friendly". The acquisition of IT skills will then assume less prominence and the underlying technology itself will become less visible as its "front end" becomes closer to the human than the machine. Such developments will have profound implications for education leading to an increasing polarisation of skills. The easily used, friendly technology for the vast majority will need to be produced by the small technological elite mentioned earlier. The implications of this polarisation for information technology education are fundamental.

But the key assumption behind the belief that education must prepare pupils for a society dominated by Information Technology is the vocational one i.e. the belief that all school pupils and students must be prepared for work involving I.T. That assumption can be examined by studying the various sectors and sub-sectors of the SIC.

Where is the information sector?

It is clear that all sectors of employment are involved in using information technology in some way. This is true of manufacturing, retail and distribution, travel and tourism, services and of course banking and finance. Just as the motor car, the aeroplane and the telephone have pervaded sectors of employment so has information technology. There is thus a current need for information technology awareness as one of the goals of education - though whether or not this aim will be any more relevant in ten years time than "motor car awareness" courses would be now is open to debate. But, to be more specific, how many people are employed directly in the Information Technology industry now and what are the implications of this direct employment for education?

The SIC does not contain a sector or sub-sector entitled Information Technology. However, four important sub-sectors can be singled out which together make up the major visible part of IT industry. They are: data processing equipment manufacture (Division 33), telecommunication equipment (344), Telecommunications (7902) and Computer Services (8394). The total numbers employed in those sectors are shown in Table 4, alongside their percentages of the total working population. Altogether the four IT sectors identified make up around 2.7% of the total workforce. It could be argued that this percentage is certain to increase substantially with the growth of IT as a world industry. This may be true in the future, though recent trends do not support this prediction. Table 5 shows that the numbers employed in two of the sectors (34 and 33) have risen by 0.75% and 3% respectively in the last four years. Figures are not available for the other two sectors for that period - however current data show that numbers employed in telecommunications have actually declined by 1.7% in the last year.

In short, the activity of providing information technology for others to use is at present a very small source of employment (2.7% of the total) and is likely to remain relatively small in the future. This single fact has important implications for TVEI curricula, other school curricula, the Youth Training Scheme and the YTS Information Centres (ITeCs).

The Service economy and the future 'information sector'

Two possible models of unemployment have been referred to earlier as the skills-deficit model and the cyclical model. The latter implies that an upturn of the economy is "just around the corner" and that unemployment will decrease as trading conditions and the economy recover. (discussed for example by Jenkins, C. and Sherman, B. (1979); Stonier (1983).

Both models have been attacked. Stonier (1983) argues that unemployment patterns are caused by structural changes within society in undergoing a revolution from an industrial to a post-industrial era. Unemployment patterns are not fundamentally altered by skills shortages or by cyclical changes in trading condition. Stonier's argument is supported by a cursory examination of statistical data. Japanese labour trends (shown in Table 6) indicate that structural changes have indeed occurred in their rather advanced industrial society. There has been a clear trend, which is still continuing, towards service industries and the so-called "information sector".

The Japanese have even coined a word for it which cannot be printed here but means roughly "servicisation". Similar though more depressing trends, can be seen in the statistical data on Britain (Table 7). Primary and secondary industry have both declined sharply while only service industries have grown.

However, one important critic of the simplistic notion of a new service economy is Gershuny (Gershuny, 1978; Gershuny & Miles, 1983). His work, and particularly his later analysis with Miles, has important implications for education. Gershuny and Miles argue that existing classifications of industry and employment (including the SIC) disguise the fact that there has been no increase in numbers of jobs which actually provide direct services to people. In fact what we are witnessing is the growth of a "self-service economy" in which services are increasingly being provided by manufactured goods. Their argument is a long and complex one - what does have greatest implications for this inquiry, however, is their warning over misplaced optimism for the future of the information sector, advanced by speculators such as Stonier. They ask of the information sector, "where is the mysterious beast to be found?" (Gershuny and Miles, 1983, p. 255). The difficulty of locating IT in the existing SIC has already been mentioned. Gershuny suggests that in the occupational classification it resides largely in the service occupations. Does it create employment and will it do so in the future? Gershuny and Miles argue that its future is far from determined:

> "While we may be sure that IT will be used in innovations in modes of service provision, in a manner analogous to the use of older technologies in the service innovations of the 1950s and 1960s, we have as yet no clear view of how it will be used. There is no single, pre-determined 'information economy' awaiting us in our future, but rather a

> multiplicity of alternatives; which of these alternatives becomes our future is to some considerable extent a matter of our own choice. And while we can be cerain that the service innovations we discuss will generate some new jobs, it is also more than likely that the development of new telematics infrastructure will actually accelerate the displacement of many categories of traditional service workers; we cannot know whether there will be net job creation until we have some idea of what sorts of service innovations will actually happen". (Gershuny & Miles, 1983, p. 256).

Future employment in the "information sector" is therefore far from guaranteed, if Gershuny & Miles' analysis is correct. The future will depend to a large extent on the development of an IT infrastructure (proposed elsewhere by Mackintosh, 1986). Their conclusions also have vital implications for education and training.

Education and training can act as a key agent in shaping the future of the information sector, as opposed to becoming a passive victim of it. Certain speculations on the 'servicisation' of the economy and the increasing power of information (Stonier, 1983) in the "third wave" (Toffler, 1980) have an air of technological determinism about them. Gershuny and Miles provide an important antidote to that determinism. Education can shape the future of employment as well as being shaped by it. This is put forward as an underlying theme for the remaining chapters, and in particular for the concluding recommendations on the position of IT in education and training.

Given that education can help to shape employment, what implications (on the other hand) do previous employment patterns have for education?

IMPLICATIONS FOR EDUCATION

Some of the implications of the patterns of employment, and models of unemployment, presented above have already been hinted at. This section will attempt to make them explicit in order to provide the context for later analyses and discussion.

Firstly, what is to be made of the prediction that society is moving towards a post-industrial era and that this shift accounts for unemployment? Figures shown and discussed earlier indeed show that employment is undergoing rapid changes. A decrease of almost 10% in employment and manufacturing in four years, alongside an increase of 25% in one of the service sectors in the same period, are rapid by any standards. However, even if structural explanations of unemployment are entirely correct they do not rule out the possibility that unemployment is made worse by skill shortages. In other words, the structural and the skill-deficit models of unemployment are compatible. Indeed, it seems that skill deficits are certain to be exacerbated by the rapid shifts in employment displayed in figure 4. What does become difficult, therefore, with rapid structural changes taking place in employment, is to determine, let alone predict, the skill shortages which are creating unemployment. This is a problem faced by any empirical enquiry into the needs of employers and the consequent role of the education system. It is equally a problem for those employed in education who are trying to relate to the 'needs of industry' and the 'world of employment'. If education attempts to respond to the demands of industry and pleas for utility, to which view of society and employment should it subscribe. The Callaghan style 'skills-deficit' critique of the education system may be valuable in times of stability and slow social change - but can it be usefully applied to education in a period of revolution? Secondly, there seems to be little evidence for any belief that future employment prospects in the "post-industrial" era will lie in large numbers in the provision of information technology. There is scarce support in either the literature (see IMS, 1986) or in the available data presented earlier for any hope that job losses in the primary and secondary sectors will be compensated for by increased employment in information technology. Thus it seems unlikely that the growth of information technology will restore the millions of skilled or semi-skilled jobs with large employers which have been lost in the last decade. If links between education and employment in the field of new technology are unlikely to be significant for the majority of pupils, then to which area of employment should vocational education be aimed? In other words, to which sectors of employment, both now and in the future, should vocational education be directed? A simplistic answer of course, which will be examined critically in later chapters, is obtained by studying Table 3 and figure 4. The growth in employment has been almost exclusively in the service sectors in the last four years, and this growth seems likely to continue at least in the near future. The service industries are, by their very nature, labour intensive and less susceptible to automation and robotization than agriculture, manufacturing or information handling. Service industries, almost by definition, involve people.

Hence, it could be argued that vocational education (and education/employment links) should focus largely on the growing service sectors i.e. Divisions 6, 8 and 9. By doing so, education for the world of work would concentrate on developing personal qualities. These would involve inter-personal skills, communication, the ability to work in a team, cooperative group work, and a pleasant manner and appearance. The development of such qualities or personal attributes would seem to be of far more vocational value to a person entering employment, from school-leaver to graduate, than narrow, specialised technological skills.

It seems ironic to suggest that in a time of increasingly developing technology, the value of personal qualities and attributes may become greater than ever. The goal of personal development for the individual may be as vocationally valuable as it is desirable in itself. This notion will be examined later in the light of empirical evidence. This is not to suggest, however, that the education system does not need to develop people with a high level of ability in technology, and in particular information technology. However, the data considered above suggest that the numbers needed with such skills will be small and at a high level.

The development of new technology in both manufacturing and information handling will be vital to the economy - indeed its health and success will, according to most economists, be essential in supporting the service sector. But as far as employment of people is concerned it may be the sectors least affected by new technology which relate to the largest numbers. This is surely the most important message to be discerned from an analysis of past employment patterns in discussing the goals of vocational education. However, optimism for future employment prospects in the so-called service sector must be tempered by the critique of Gershuny and Miles outlined earlier.

One final, though more general point is worth raising in sketching the context for subsequent analysis of the relationship of employment patterns to the goals of education and training in IT. This point relates back to Callaghan's pleas for relevance and tools-for-the-job, and to the skills-deficit models of unemployment in the White Papers mentioned earlier. The relationship of education to employment is not a clear one. It is in some ways a chicken and egg situation. Do skill deficits in employment create demands in the education and training systems? Or does skill creation in education and training improve the employment situation? In other words, can training create jobs? Or do changing patterns of employment create certain needs in education and training?

To put the problem in another way, in discussing the connection between employment patterns and the goals of education (and training) it is rarely clear which leads and which lags. This is an issue which will be followed up in later chapters. Chaper 3 begins the analysis by discussing some of the key notions in 'education for employment', including the ideas of vocational and pre-vocational education and the current emphasis on the language of "skills", perhaps resulting from the skills-deficit model of unemployment.

CHAPTER 2: NOTES

(1) A full discussion on the impact of unemployment on education is given in Watts, A.G., Education, Unemployment and the future of work (Open University Press, 1983).

(2) Reported in The Times (18.10.76), The Times Educational Supplement, (22.10.76), and printed in full as "Towards a National Debate" in Education, 22.10.76, pp. 332-3).

CHAPTER 3

EDUCATION FOR EMPLOYMENT: THE LANGUAGE OF VOCATIONAL EDUCATION AND THE NEEDS OF NEW TECHNOLOGY

The previous chapter analysed recent employment patterns, particularly as they relate to IT, and took a cautious look at their implications for education and training. This chapter begins the analysis of the relationship of education to employment by considering critically the concepts used in the discussion and in particular the language of vocational education and training. The chapter goes on to examine the relationship of vocational education to new technology and the demands which it might present in the future.

VOCATIONAL EDUCATION

The growth of the language of skills and pre-vocational education

Callaghan's so-called Ruskin College Speech of 1976 contained an attack on informal, modern teaching methods, a 'concern for standards', and a criticism of the poor relationship between schools and industry. In short, he questioned the very function of schooling by suggesting that schools were not providing the necessary skills. The two quotes from the Ruskin College speech given in Chapter 2 serve to illustrate that point.

In a sense, Callaghan launched "educational newspeak". Educational objectives were being defined in terms of skills - not a new stategy but one which served Callaghan well and, more importantly, provided a framework for the language of the Government White papers in the 1980's discussed earlier. The language of skills, skill-deficits, skill-shortages, skill centres, skills training and skills in new technology is now firmly embedded in educational parlance. We hear of "skills for the future", "relevant skills", "the skill demands of new technology" and the "skills needed to survive in the modern world". One aim of this chapter is to examine the notions behind the rhetoric, and to begin to consider whether an education based on skills has either intrinsic worth or economic utility.

The chapter contains what might be considered an unlikely mixture. Examples of the use of the terms skill, vocational and pre-vocational education are followed by a critical discussion of these terms, particularly the notions of specific and generic skills. This use of language is then related to the needs of employers and the language in which those needs are phrased. In particular, the demands which will be made of Britain's education and training systems from the field of information technology is examined by considering both British initiatives and the Japanese approach. Is the rhetoric of skills of value in meeting the educational demands of new information technology?

The concepts of pre-vocational and vocational education

The notion of vocational education is in itself difficult to interpret. "Vocation" is usually associated with training so that the idea of "vocational training" makes perfect sense. Training is linked to a specific job, career, skill or vocation. When discussing training, it always makes sense to ask "training for what?". Indeed the notion of training makes no sense at all unless it is a training as or for "something". A person can be training as a car mechanic, training for a Judo competition, or training as an accountant. To say that someone is training always begs the further question as or for what. Education is a very different concept. Education, unlike training, can stand on its own without being linked to some other aim, goal or vocation. This is perhaps why the concept of "vocational education" is almost a contradiction to certain purists. But, given the instrumentalism or "new vocationalism" (a phrase coined by Bates et al, 1984) set in motion by James Callaghan it has now become increasingly commonplace to ask of education, "education for what?". Hence, the notion of vocational education has become more widespread and perhaps more palatable as "education" is interpreted as "training".

But the notion of pre-vocational education still remains an enigma to translate. Can you imagine a teacher trying to explain the idea to a worried parent?

Teacher: "Well, it's the education that yor child gets before he(she) starts on his(her) vocational education."

Parent: "Well, what's vocational education, then?"

Teacher: "Well, it's the education your child gets once he(she) has finished his(her) pre-vocational education".

Dearden (1984), with his usual rigour and clarity, analyses the notions of vocational education and training in a valuable way (though he sheds no light on the notion of pre-vocational education, so at least I am in good company). Dearden's main general point is that education and training are "different but not necessarily mutually exclusive". In other words, the same learning experience may qualify to be called either education or training, or perhaps both. One such area at the intersection of the two concepts may be vocational education, which could therefore equally be called vocational training. This would be in sharp contrast to other experiences where the labels "education" and "training" imply totally different activities. Sex training and sex education (which Dearden quotes as an example from Peters, 1966) will provide totally different experiences - if the former were adopted on the school curriculum, for example, it might cause far more parental anxiety than the latter.

However, vocational training could only be worthy of the term "vocational education" if it were "liberally conceived", and included "learning about the nature of work, discussing its forms and contexts: a version of careers education in fact". (Dearden, 1984, page 65). If it were conceived in this way then the notions of "vocational training" and "vocational education" might indeed be synonyous, and there might also be some meaning for the notion of pre-vocational education in terms of the wider more liberal conception which Dearden describes.

In practice, however, the notion of vocational training is almost always translated in terms of "skills" which can be specified and stated. If we use Dearden's perfectly acceptable view that education should involve "the development of knowledge and understanding in breadth and depth" and a "degree of critical reflectiveness and corresponding autonomy of judgement" (Dearden, 1984, page 63) then learning experiences involving only skills cannot possibly be called "vocational education". This assertion rests on the analysis of "skills" which now follows.

THE LANGUAGE OF SKILLS

The interpretation of vocational education, used synonymously with vocational training, is given almost entirely in terms of skills in the White Papers cited above. Similarly, the aims and content of the Youth Training Scheme (YTS) are based firmly on a Core Skills Programme, consisting of a set of 103 identified skills. This approach is in turn based on the influential Institute of Manpower Studies report (No. 39), FOUNDATION TRAINING ISSUES. The language of skills is also employed in the 1985 White Paper, BETTER SCHOOLS, which talks of the "skills and attitudes needed for adult and working life" (paragraph 47) and "the issue of how best to fit work-related skills within full-time education". In addition, the documents of both the Further Education Curriculum Review and Development Unit (FEU) and the Manpower Services Commission (MSC) have relied heavily on the notion of skills in describing aims and content(1). I do not propose to analyse any (let alone all) of those documents in detail here. A detailed and rigorous analysis of the documents on which YTS is based, for example, can be found in Ruth Jonathan's paper on THE YOUTH TRAINING SCHEME AND CORE SKILLS (in Holt, M. (ed.), 1987, pp.89-119).

This section will examine briefly the notion of a "skill" and then go on to consider its succesor, the generic or transferable skill. In so doing, I hope to show that a worthwhile vocational education can never be defined solely in terms of skills. The language of skills may be necessary, but it can never be sufficient.

In addition, a skills-based education may not be very valuable to employers, particularly those involved in new technology. The final sections of this chapter examine the value of the language of skills in matching education and training to the needs of employers in new fields such as information technology. My contention is that a narrow skills-based definition of education makes neither conceptual nor economic sense.

The notion of skill

One valuable document summarising many of the publications which advocated a re-definition of education in terms of skills is entitled SKILLS FOR SCHOOLS (Perry and Barnett, 1985). This booklet bravely tackles the challenge of defining "skill" by separating three aspects of human activity:

> "Any human activity requires three elements: knowledge to understand the context of the activity and predict outcomes; skills with which to act; and the attitude or motivation to act."(p12)

This attempt to analyse human activity into three components may be brave, but conceptually it is crude and confusing. Can the three elements really be separated in this way? Can a person acquire a skill without knowledge, or any worthwhile knowledge (other than what A.N. Whitehead called "inert ideas") without exercising and acquiring some degree of skill? Knowledge, skill and attitude are both conceptually and practically inseparable.

The rigid knowledge/skill/attitude division is reminiscent of Bloom's three domains of objectives: cognitive, psychomoter and affective. But, as Rowntree (1985) points out, "skills can be cognitive or affective as well as psychomotor" - the skills of literary criticism, violin playing or counselling a patient are given as examples. This broadening of the notion of skill to include cognitive and affective aspects brings the notion much nearer to

Ryle's (1949) concept of knowing how as opposed to knowing that. Unfortunately, this broader and more acceptable notion of skill is not applied in the SKILLS IN SCHOOLS document, or the previous FEU, IMS and MSC publications on which it relates. This is clear from its definition of a skill:

> "A skill is the ability to undertake an action under given circumstances to a defined degree of expertise".(page 12)

That definition clearly relies on a psychomotor notion of skill and a behaviourist-based view of education. Is skill necessarily tied to action? Can skills not involve "mental action"? There seems to be no logical connection between a skill and a physical action. Can all skills be governed by a "defined degree of expertise"? If so, where does this leave the mental processes in the exercise of a skill?

The bias towards behavioural and psychomotor skills is shown in the lists of skills which are given as part of a possible 'core' of identifiable skills required by school leavers. Included in the list are such skills as:

Read and write numbers	Count objects
Pull, push, lift and carry	Cut materials with scissors, shears etc.

In fairness, however, many of the 'core' skills are on a higher level and are listed as:

Give answers	Deal with complaints
Advise	Explain something
Decide job priorities	Describe or give information

But surely not one of the latter group of skills makes any sense or carries any meaning without a context. How can a person possess "advising skill" which is context and knowledge independent? This is the first major point that I would like to propose in discussing the notion of a skill. A skill cannot exist except within a certain context, and within a framework of prior knowledge and understanding. How can a person "decide on job priorities" without an adequate understanding of the relevant context, the necessary information and the prior knowledge of either facts or general principles.

This, in my view, is the essential mistake in the rhetoric of skills i.e. the belief that a worthwhile skill can be separated off and defined in isolation from the context of understanding and knowledge which surrounds it. That mistake is made in both science and technology education. Lists of scientific skills are given, for example, which include "observation skills", "the ability to hypothesise", "predicting and informing", "controlling variables" and so on(2). Yet not one of these science skills has any sense or meaning in isolation from the knowledge-base, framework or paradigm (Kuhn, 1970) which forms the foundation of science. As Popper (1959) is so often quoted a saying, observation is theory-laden. The same is true of hypothesising, inferring, controlling variables and all the other skills involved in science. They can only be developed within the knowledge framework or paradigm of science. A science or technology education which is biased totally towards skills will be as meaningless and empty as one which concentrates solely on content or propositional knowledge (Ryle's "knowing-that").

In short, skills without knowledge are empty. This will be particularly true in "new industry", as I will argue later, which is by its very nature knowledge-intensive (Alvey, 1982).

Generic and transferable skills

Two criticisms of a skills-based approach to education and training are:

(i) that it often produces lists of skills *which, although easily* definable, are often trivial and demeaning.

(ii) that a narrow, and specifically-stated skills based approach to training is hopelessly vulnerable to changes in society and in technology.

As Ruth Jonathan (1982) puts it, "the more specific the skills, the shorter their useful life". These twin criticisms of trivialisation and vulnerability to change have pushed forward the notion of 'generic' or 'transferable' skills. These higher level skills are "fundamental to the peformance of a number of activities carried out in a range of contexts", and are significant for vocational education because they are "generic to a wide variety of occupations and are transferable between vocationally specific areas". (Perry and Barnett, 1985)

I would like to examine some of these generic skills and show that, as with specific skills, few of them carry meaning if seen as context and knowledge independent. To hold them up as educational goals in themselves, therefore, is both vague and conceptually unsound. Lists of generic, transferable skills often include the following:

problem-solving	information handling
planning	decision-making
diagnosis	communicating

Take "information-handling" for example. This is often put forward as one of the key skills for the future, and who could doubt this is an age where information is said to be a vital resource (Stonier, 1983) and where the possession of propositional, factual knowledge ("knowledge that") can only decrease in importance as an educational goal. Information skills will involve the ability to collect, prepare, code and retrieve information, in conjunction with the endless capability of new information technology to process and communicate this information. But information skills, vital though they may be in serving education, can never provide an educational goal in themselves. Information skills alone, without ends and purposes, have no meaning or value. They cannot exist in a vacuum. Education does not involve the passive handling and acquisition of information. Active and meaningful education involves selecting, interpreting and transforming information according to the learner's previous experiences, present needs and purposes, and prior knowledge. Information skills are, to caricature Popper, knowlege and context laden (a point fully argued in Wellington, 1984)

Similar points can be made about an equally valued generic skill, "problem solving". Can such a skill be knowledge and context independent? In other words, can the ability to solve problems in one domain transfer across to another? The question of generic skills, therefore, rests squarely on a debate which is totally unsettled and indeed has occupied psychologists for much of this century: transfer of learning. The issue, like the heredity versus environment debate, is by its very nature unlikely to be decided conclusively. Perhaps the belief that skills can be transferred from one area to another is, like pseudo-scientifico hypotheses, incapable of falsification (Popper, 1959). Yet the bulk of the literature which puts forward generic skills as the aims of education and training totally ignores the question of transfer. (See, for example, Bradshaw, 1985).

The same question mark can be placed over the generic skill of "decision making". Is there any evidence to show that decision-making in one domain, e.g. the art of Cordon Bleu cooking, is transferable to another domain, e.g. car repair and maintenance? Indeed, how could such a belief ever be falsified let alone confirmed? Dearden makes a similar point in discussing "good judgement":

> "...simply because good judgement can be exercised in both the stock market and in landing a hot air balloon, it does not follow that there is some general skill of 'good judgement' which is common to both and in which we could be trained free from any particular context." (Dearden, 1984, page 60)

My contention, therefore, is that the language of generic skills can be criticised on two related counts. Firstly, skills of any kind are context and knowledge dependent - skills without knowledge are empty. Secondly, the belief that there are genuine, transferable skills which are the proper aim of education and training totally ignores the contentious question of transfer.

A third objection to the language of transferable skills, which is based on political grounds, is given by Cohen (in Bates, et al, 1985, page 113). He argues that many of the new initiatives in training are based on "a hidden agenda for redeploying the notion of skill itself". By dissociating skill from specific practices and defining it in terms of "certain abstract universals", a pool of "abstract labour" can be created thereby undermining the control of skilled manual workers over conditions of entry and training in their own trades. This may well be as much a consequence of new technology, however, as a political ploy - a point which Cohen acknowledges:

> "What 'transferable skilling' corresponds to in reality is the process of deskilling set in motion by new information technologies". (Cohen, 1985, page 113)

The question of the relation of skills to the problems posed by new technologies will be returned to later.

A similar attack on the redeployment of the notion of skill is given by Ann Wickham in Dale (1985). She suggests that the notion of skill has ben redefined which, in turn, has given "training" a new meaning:

> "In the past the notion of skill had been associated with craft work, with a combination of mental and physical dexterity in a particular area of work. Under the aegis of the Special Programmes Division (of the MSC) a much wider definition of skill came into use. Skill was regarded more as a way of organising activity and involved a combination of what are now regarded as individual skills and general skills, that is numeracy, communication and practical skills, together with social and life skills, attitudes to work and a knowledge of working life. Training was ... given a new meaning which was removed from that traditionally used." (Wickham in Dale, 1985, page 104).

This redefinition of the term "skill" can be seen in its recent broadening to include "social and life skills", "employability skills", "communication skills", "attitudes to work", "preparation for life skills", and so on. It is as if the concept of skill has ascended to a new level to embrace not only competencies but also abilities, aptitudes, dispositions, and attitudes. It needs only to subsume the concepts of knowledge, thinking, understanding and motivation to have taken over as the umbrella term covering the whole of education. We may soon be talking of the skills of understanding and knowing just as we already talk of thinking skills, reading skills, social skills and even moral skills.

Hart (1978) argued with emotion against such distortion of language:

> "If you don't hold out against talk of 'skills', if you don't see that 'skills' only account for part, and that the less important part, of what we learn, you are driven to conclude that there is nothing for which a man can be held responsible or in which he can see himself mirrored". (page 215)

Hart's paper makes two valuable points. Firstly, that talk of "skills is simply a kind of incantation, by which one creates the illusion that one is actually saying something about education". In other words the addition of the label "skill" actually adds nothing descriptive. How, for example, does "reading" differ from "reading skill"? The same is true of the language launched by Callaghan's Great Debate. Much talk was, and is, heard of "relevant skills". Those terms have yet to be given any concrete, descriptive meaning. Indeed the noun "relevance", and the adjective "relevant", have no meaning on their own. Like the term "skill", they are almost always used as terms of incantation, a seal of approval, having no descriptive but only emotive meaning. To describe a skill as relevant is meaningless. We need always to ask the questions "relevant to what?" and "relevant to whom?". This confusion over relevance is particularly important in considering the "skills relevant" to new technology.

Hart's second main point, as I interpret it, is that the acquisition of skills is, in a sense, an activity of tacking on or appending skills to bodies. It is a largely impersonal process. In contrast, truly educational processes will profoundly affect and alter the person involved. This is not true of skills, as they are traditionally conceived:

> "...education, whatever else is involved in it, is about the individual person and his development; and it's been my contention that only that which is more than simply a skill can contribute to that development, the continual forming and reforming of the person. So that when receiving an education is conceived of, as it is so often today, in terms of acquiring skills, it is conceived of as something superficial." (Hart, 1978, page 213).

This point leads in to the next two sections of the chapter. Does industry want bodies with skills "appended" to them? Do employers in fact phrase their requirements in the language of skills? Does it make either practical or conceptual sense to discuss the needs of technology in terms of "relevant skills" and "skill shortages"?

The language of skills and the needs of employers

An important article by Gilroy (1983) discusses the value of conceptual analysis in clarifying the work done in empirical research - similar points are made by Barrow (1984) in GIVING TEACHING BACK TO THE TEACHERS. Gilroy implies, however, that it is not only the "philosopher" who is "competent to identify and resolve linguistic confusion". There is a role for the "empiricist as philosopher", as he expresses it, in direct contrast to John Locke's under-labourer conception of philosophy. (Locke, 1690)

This is surely the case in examining the language of skills. Armchair analysis may be necessary but it is not sufficient. Valuable progress can be made, in my view, by interviewing employers in depth to probe their "needs" and requirements and in particular (in this context) to examine the language in which their needs and demands are actually framed. One such study, albeit on a small scale, aimed at clearing some of the conceptual undergrowth (to use Locke's analogy) is reported in Wellington (1986a), and is summarised below.

It is clearly a huge task to identify the "needs" of employers in terms of the skills which they require of school-leavers and trainees. The range of employers will be so vast in terms of numbers employed, on-the-job skills, and the nature of employment that there may be no common ground. With this proviso in mind, a small pilot research project was carried out which involved detailed interviews with a small sample of employers from service industries to so-called "hi-tech." employers.

The interviews were conducted in a fairly unstructured way, although some specific questions were asked of all the staff involved. The person approached and interviewed was in each case the "development and training" or personnel officer of the company. In fairness to those interviewed no specific comments and quotes will be included here - I will simply sum up some of the general principles which came through strongly, and also select some of the more interesting remarks on skills and specific training which relate to earlier parts of this chapter.

The strongest message which came through in this pilot study is that the needs of these employers are rarely framed in terms of skills required of school leavers - their requirements are often stated in the language of attitudes and dispositions. This is perhaps the most important message as a response to the 1981 and 1984 White Papers - they are making a basic "category mistake" in framing the needs of employers and therefore of vocational education in terms of skills. What employers seem to be demanding of school-leavers and YTS trainees, is a collection of general attitudes and dispositions. The "attitude" which came at the top of the list was "interest and motivation". This was felt to be the most important quality in a school-leaver. Other attitudes and dispositions considered important were: initiative, confidence, self-belief and maturity (particularly in the service industries).

In none of the interviews were skills specifically mentioned. Each of the employers interviewed was asked which skills they required of new employees - none listed skills other than numeracy and literacy, which (incidentally) they felt were of the required standard in the young people they apointed anyway. The so-called hi-tech. employers were asked specifically about "computer literacy". Did they want their employees to be "computer literate" before joining the company? This notion was dismissed. The kind of "computer literacy" (a virtually indefinable notion anyway) they might receive before employment was not felt to be of use once they had joined the firm. To be capable of programming a microcomputer was not felt to be of prior value. Perhaps the only useful skill in connection with computers was felt to be in the use of a keyboard.

One rather depressing comment was made by a national hi-tech. employer. They suggested that school-leavers were not likely to be taken into the hi-tech. side of the industry at all. Recruitment to this facet of their company would be entirely at graduate level and above. Even then (incidentally) the graduates appointed would not necessarily be in Computer Science, who were often receiving training in the wrong computer language e.g. Pascal rather than Cobol.
Some of those interviewed did comment, of their own volition, on the Youth Training Scheme. They saw YTS largely as a grading or

interviewing system which enabled them to "have a good look" at a prospective employee. They felt that it was an ideal opportunity to see if that trainee had the right attitudes and dispositions, such as those already mentioned. One described YTS as a "year-long interview", a comment which has since been used by many employers.

I would not suggest that this exploratory empirical enquiry with its small sample could be used to form any definite conclusions on the requirements of employers. In later chapters, however, the issues raised by this pilot study are followed up in far greater depth. The study did have value in indicating a gap between the language used in statements and documents on pre-vocational education and the language in which employers and industry couch their requirements. In particular, the study posed the following questions. Should discussions and statements on vocational education be framed in the Callaghan language of "skills", "relevant training" and "tools-for-the-job"? Or should the aims and philosophy of vocational education be couched in terms of attitudes and dispositions? Is there any sense in the notion of "relevant skills" or "skills for the future" in a society which may be entering a new phase? If not, then what meaning does the very notion of "pre-vocational education" hold? With an increasingly uncertain future for employment, depending more and more on the rapidly changing field of information technology, does the notion of vocational education make economic, let alone conceptual sense?

These questions will be discussed in the final two sections of this chapter, firstly by considering the likely "skill demands" of new technologies, and then by sketching the response of Japan to the education and training needs imposed by technological change.

SKILL DEMANDS AND INFORMATION TECHNOLOGY

Key documents

A crucial document was published in August 1984 by the Economic Development Committee (EDC or "little Neddy"), entitled CRISIS FACING U.K. INFORMATION TECHNOLOGY. This publication described the critical skill shortage in Information Technology which is apparently holding back the U.K. industry:

> "Too often contracts are being lost, and employment opportunities lost with them, because of the lack of a few key engineers." (page 10)

But at what level are these skill shortages? The answer given by this document is that the shortages occur at graduate level and above. For example:

> "The problem is critical even before the effects of the University Grants Committee cuts have really shown in graduate output." (page 10)

In other words (according to this document) the critical skill shortage holding back the U.K. "Information Technology industry" is clearly not at the level of 16 or 17 year old school leavers who are likely to opt for the Youth Training Scheme. It is at the graduate level, of a "few key engineers". Skill shortages at this level, according to the document, are resulting in a lack of demand for employment at lower levels. This is perhaps a more subtle version of the skills-deficit model of unemployment i.e. lack of the right skills at graduate level leading to a lack of demand for labour at lower levels. This more subtle version of the skills-deficit model, however, is not even hinted at in the 1984 White Paper.

The EDC report also includes a passing criticism of vocational education and training:

> The UK has a multitude of institutions and agencies engaged in education and training but they appear to have difficulty in responding to the now very insistent signals from the market for skilled people and developing a consistent response."

But what "signals" are being sent from the market for skilled people? What skills do employers actually require, or at least say that they require? This is clearly a case where the rhetoric of skills and skill demands needs to be translated into reality. Clear signals are needed from employers so that education can be expected to develop a "consistent response". There can be no substitute for detailed empirical investigation here.

A second key publication in predicting the "skill demands" of new technology is the report of the Alvey Committee on the future of IT and the so-called fifth generation of computers. A large proportion of the report was devoted to the education and training which would be needed to provide the human resources for Britain's advanced information technology programme into the 1990's. Perhaps the crux of the whole report for the future of education in IT is contained in one short statement:

> "Information Technology is knowledge intensive."
> (Alvey, 1982, page 59

In other words, IT industry is not labour intensive. The addition of skilled personnel for Britain's advanced IT programme is quantified by Alvey in terms of thousands, not even tens of thousands. At what level are these personnel required? Alvey suggests that "urgent action is needed in the higher education sector" despite the fact that:

> "restrictions on expenditure in higher education, whatever the intentions, have tended to fall across the board. IT has not escaped." (Alvey, 1982, page 60)

So what action can be taken for students in the 14-18 range of education and training? Where does this leave the emphasis on "information technology skills" and "computer literacy" at the heart of YTS schemes, the ITeCs and the TVEI? These are the central questions ultimately examined after the empirical enquiries described in later chapters.

Lessons from the East: the Japanese approach to skills and vocational education

A full-page advertisement began to appear in the newspapers early in 1986, from The Mirror to the so-called quality dailies such as The Guardian. The advert warned the Japanese of the advent of Spikey Dodds, Tracy Logan, and others with names like Joe Bloggs, about to embark on the new two-year Youth Training Scheme. Spikey Dodds, for example, will "begin his course by trying out several different skills before he chooses the one he'll train for through to the end of the second year". By the end of the course he will have "a skill, a certificate to prove it, and a better chance of getting a job". This may well prove true, though at the time there was little evidence to support such optimism. But the point I would like to take issue with comes in the next paragraph of the advertisement:

> "Our competitors in the Far East and Europe have been training their young people like this for years."

Presumably, one of the countries implicitly referred to here is Japan. The suggestion, therefore, is that Japan's education system has been training youngsters by allowing them to "try out several different skills" before choosing the one which they will train for and obtain a certificate in. This is patently untrue, and one does not need to refer to erudite publications in the bowels of University libraries to prove it. A series of articles on the evolution of Japan's education occurred in LOOK JAPAN from May to December 1983. These articles, written by leading Japanese economists and educationalists, indicate that the skills-based vocational training alluded to in the YTS advert may have taken place in the 1960's and early 1970's but has now been superseded by a totally different educational drive.

An indicator of Japanese misgivings over narrow skill-based training came in the 1981 publication JAPANESE INDUSTRIAL RELATIONS, SERIES 7 (Page 31):

> "School education now provides both general and vocational courses at the secondary level, but the general public tends to regard the former as preparing intelligent youths for university entrance and accordingly for better employment opportunities and the latter as accommodating the less intelligent who are to enter lower level occupations. Industry generally expects schools to turn out youths with a good level of academic achievement and adaptability and does not attach much importance to pre-employment training designed to prepare young people for specific occupations."(3)

The first sentence of this paragraph gives an early warning of the potential divisiveness of vocational curricula, discussed five years later in TIMES EDUCATIONAL SUPPLEMENT articles on studies of the new TVEI (see, for example, "TVEI: very good and very bad", T.E.S., 15/11/85). The second sentence indicated that the world's most successful industrial nation would encourage its youth to follow a general education rather than vocational training in the 1980's. This view is made crystal clear later in the document:

> "...the emphasis (in school education) is on developing general intelligence rather than specific skills."

The 1981 statements have since become a reality. In 1985, no less than 94% of Japanese students stayed on for "senior high school" after leaving the compulsory junior high school. Of that 94%, only 10% enrolled for specialist industry schools. Judging from a 1986 T.E.S. article (7/2/86, "Books first for Industrial Pacesetters") attitudes changed little in five years:

> "Despite Government efforts to make work-related courses more attractive to students, the vocational high schools are still generally viewed by pupils, parents and employers as being second-best. The demand for places at vocational schools has declined, and many entrants are students who have failed to gain entry to a general high school."

Such enduring attitudes are coupled (both as a cause and as an effect) with the huge growth in Japan's higher education, sometimes called its "transfer to a higher education society". The proportion of the relevant age-group staying on for higher education in 1985 was just under a phenomenal forty per cent compared with just over twenty per cent in the United Kingdom.(3)

An important part of Japan's higher education in ensuring its industrial success was, of course, the high-level engineering education provided. At the start of the 1980's Japan's total output of graduate engineers was between five and six times higher than ours at about 75,000, compared with Britain's 13,000 (relative populations approximately 120 million to 56 million). This poor comparison still continues at a time when Britain's information and manufacturing industries are supposedly desperate for electronic, electrical, mechanical and software engineers at graduate level.

Britain's principal area of competition with the Japanese in the next decade will almost certainly be in the area of information technology. The Alvey Report indicated Britain's needs for the future:

> "...there is a requirement for a new breed of 'information engineer' with a wide understanding of the potential applications of IT to industrial needs. The supply of graduates with skills relevant to IT must be increased. The undergraduate output is currently some 6,500 per year. This is wholly inadequate to meet our future requirements."(page 62)

How has Britain answered Alvey's plea?

As we have seen, the central response to the keenly felt need for IT education has been to provide every school in the country with at least one computer and some with as many as thirty or forty. Britain's populace now has the largest number of home computers per head in the world. This is in direct contrast to the Japanese approach to computer education. The 1984 JAPAN EDUCATION JOURNAL reported that only 0.1% (i.e. one in a thousand) of its primary schools had microcomputers at that time. Less than 2% of its lower secondary schools had computers, though the figure reached 45% in its upper secondary schools. However, the computers in the latter area were used largely as an administrative and management tool. The notions of "computer studies", "computer literacy" and "computer-related skills" so widespread in this country, have no place in the Japanese approach to education:

> "The school curricula in Japan are designed to give children a broad and basic knowledge which is necessary in order to grasp and enjoy a wide range of ideas and activities. In the field of science and technology, Japanese children are taught concepts, principles and laws of basic science and mathematics, which are the basis of industrial technology. Computer technology is not yet considered to be part of the required 'basic knowledge'."(3)

It seems that the abacus is a more common learning tool in Japanese schools than the computer.

I am not suggesting that we should attempt to copy Japan's approach to computer education, or its education system in general. Britain's culture, its hidden curriculum and its material resources are too vastly different to make that a possibility. I am suggesting that we should radically re-think our approach to vocational education (not least in the IT field) in the light of lessons learned from the Japanese, and in my view of our need to compete with Japan in the development of new "knowledge intensive" industries.

It makes little sense to base a new and expensive programme of skills-based vocational training on a view of a system "in the Far East" which is at best out-dated and at worst purely fictional.

CONCLUDING REMARKS

My main aim in this chapter has been to examine the rhetoric of skills and the language of vocational education, and then to begin to compare it with the needs of new technology and the contrasting approach to education for industry in Japan. My first conclusion is that the language of skills so often used in publications on vocational education is frequently biased towards a behaviourist, psychomotor conception of skill. That conception involves, in a sense, abstracting skills from any particular context or knowledge-base and describing them as if (firstly) they exist per se and (secondly) they can be appended, attached or tacked on to an available human being by the appropriate form of training. In an effort to make that "training" more akin to "education" the notion of general, generic, transferable skills has been brought forward. My argument is that both specific skills and generic skills have little meaning in a total vacuum.

Skills are knowledge and context dependent

Further support has been given to the language of skills by claims that Britain's education system must provide "relevant skills", skills which relate to "the technological aspects of working life", or skills which can respond to "the needs of new technology". My own view is that no reliable evidence yet exists either to indicate precisely what these skills are (specific or generic) or even to show that the needs of employers in new industry are actually phrased in terms of skills. Existing evidence, both from British publications and reports on the needs of IT industry and from a consideration of Japan's educational response, indicates that a purely skills-based approach will not enhance new technology. However, a substantial amount of empirical work needs to be done in this area in relating the needs of employers to the future provision of vocational education and training (see Chapters 8 and 9).

Recent attacks on the "new vocationalism" (Bates, Dale, Fiddy, Varllam etc.) are rightly directed at vocational training with a narrow skills-based emphasis. But they should not also be seen as a condemnation of a satisfactory and economically essential concept of vocational education which has yet to be fully worked out, let alone implemented. That notion of vocational education would involve education for technological change and progress, though it would not involve the appendage of skills deemed necessary and "relevant" onto the available "manpower". The notion would involve the ability to critically evaluate technological change and the future quality of life - it would not see vocationalism as providing a "skill resource for a Brave New World of technological change" (Jonathan, 1985).

A balance of critical evaluation, knowledge, understanding and the skills involved in those contexts must form the ingredients of a future vocational education which will provide the human resources for Alvey's programme of advanced information technology. That balance is hinted at by David Young in discussing a philosophy of the vocational which unfortunately has never been put into practice:

> "What our education should be is a balance between the vocational and the academic, between the theoretical and the pragmatic, between knowing how and knowing that. There is no correct balance, that depends on the individual, but balance there must be." (Young, 1984, page 14)

Yet the balance between theoretical and pragmatic, general and technical, liberal and vocational may have become less rather than more stable since Young's 1984 speech. Gulfs and divisions between the two extremes have grown worse throughout the education system - in schools, colleges, polytechnics and universities. Indeed, the gulf may be in danger of being increased by new initiatives, which many (for example, Holt, 1983) feel will divide rather than unite the curriculum. But balance must remain the over-riding aim, particularly in science and technological education.

This was Aldous Huxley's major concern almost fifty years ago in ENDS AND MEANS:

> "...both the existing kinds of education, technical as well as academic or liberal, are unsatisfactory. The problem before us is this: to amend them in such a way that technical education should become more liberal, and academic

education a more adequate preparation for everyday life in a society which is to be changed for the better." (Huxley, 1938, page 195)

Change is surely needed in an education system fifty years on which, on the one hand, is failing so many young people yet, at the other extreme, is failing to supply the human resources needed for technological growth. But the necessary change cannot lie in either the "new vocationalism" or the pleas to retain the liberal, general education which is rejected by so many school students. A synthesis of the vocational and the general, the technical and the liberal, the theoretical and the practical must form the basis of the future curriculum at all levels of education A curriculum divided between the two opposites, with some students opting for one pole and some for the other, can only lead to further divisions within society and the "inappropriate" development of technology.(4)

A course must be steered between two fictional extremes: the technological desert of Huxley's "Brave New World" based on a highly trained but uneducated elite making progress at all costs; and a nation which cannot advance into the information era because it lacks the human resources in new technologies. That course can be achieved by establishing a new tradition of liberal technological and scientific education in which people learn to consider ends as well as means. The "language of skills" is totally inadequate in describing such an education.

CHAPTER 3: NOTES

(1) Beginning, for example, with A BASIS FOR CHOICE (DES, 1979) and SKILLS FOR WORKING LIFE (MSC, 1981)

(2) Listed, for example, by WARWICK PROCESS SCIENCE (Warwick University/ASE, 1986) and SKILLS IN SCHOOLS by Perry, J. and Barnett, C. (Longman, 1985)

(3) The following sources have provided all the data on Japan's approach to vocational education:

(i) LOOK JAPAN, May to December 1983
(ii) JAPAN INDUSTRIAL RELATIONS SERIES, NO. 7 (1981)
(iii)JAPAN EDUCATION JOURNAL
(iv) JAPAN 1985 (Japan Institute for Social and Economic Affairs.

(4) A notion discussed fully by Burns, A. (1981) in THE MICROCHIP: APPROPRIATE OR INAPPROPRIATE TECHNOLOGY? (Chichester: Ellis Horwood).

CHAPTER 4

INFORMATION TECHNOLOGY IN EDUCATION: AN OVERVIEW

Thus far the background to information technology education has been considered, firstly by examining employment patterns in recent years and secondly by considering the growing emphasis on vocational education since 1976 and its relation to new technology. In this chapter some of the issues in the policy and practice of IT education are introduced which are examined fully in the inquiries of Chapters 5 and 6 and then subsequently in the analysis of links between education and employment in IT.

The chapter will provide an overview of the main events directly influencing IT education in the last decade, in order to place the subsequent inquiry in its educational context. The key landmarks influencing school IT education are first considered, along with their effect on primary and secondary education. Some of the major articles, publications and events leading to the growth in vocational education have already been discussed, particularly as they relate to the birth of the Youth Training Scheme (YTS) and the Technical and Vocational Education Initiative (TVEI). The principal interest of this inquiry of course, is the IT component of these initiatives and these will be considered in detail in Chapters 5 and 6. Near the end of the chapter, a brief comment will be made on changes in IT education in further and higher education, leading to an overview of IT education at all levels, and a discussion of the links between them.

The main aim of this chapter is to raise questions about IT education and training which are taken up in the empirical study.

MICROS. INTO SCHOOLS

No single item of educational technology has ever received the financial support from central government provided for the microcomputer. As this chapter will show, a total of £62.5m has been centrally committed to the school micro since 1981.

From 1981 to 1984 the Department of Trade and Industry (DTI) gave £16 million to the "half a micro" initiative, enabling every primary and secondary school in the country to purchase a micro. at half-price, the other half coming from the Local Education Authority. This meant that in only three years virtually every school in the country had acquired at least one microcomputer, some had between ten and twenty, while by 1985 a few secondary schools had as many as fifty. Most were the BBC "B" micro. built by Acorn, with some authorities choosing the Research Machines (RML) micros, and a smaller number purchasing the cheaper Sinclair Spectrum (information collected on 1986 provision is given in Chapter 5). All micros. purchased under the scheme were British.

THE GROWTH OF 'COMPUTER STUDIES'

Prior to the DTI Micros in Schools scheme, Computer Studies as a secondary school subject was on the fringe of the curriculum, and as an examination subject its entry figures were at a similar level to Spanish, Geology and Music. By 1984 examination entries had virtually tripled to place the subject firmly in the mainstream of the secondary curriculum (Tables 8 and 9).

This strategy for introducing computer education into the secondary school curriculum was, however, already beginning to be questioned. Firstly, the subject COMPUTER STUDIES was rapidly becoming the "domain of the boys" with a boy:girl ratio of 2.4:1 at the 1984 'O' level entry, a male bias exceeded only by Physics in the Top 12 with a male dominance of 2.7:1. Secondly, questions were raised about the content of COMPUTER STUDIES courses. The course content often involved topics such as the history of computing, the representation of numbers and characters in binary notation, programming in BASIC, and the study of Logic, which the subject's critics considered neither educationally worthwhile nor vocationally relevant. Finally, the subject at school level received criticism from "on high" both in the influential Alvey Report, and from Universities and Polytechnics. The latter group failed to favour candidates for degree entry in Computer Science with qualifications in that area at school level, preferring traditional 'O' and 'A' levels. The Alvey Report went further, suggesting that school computer education of the wrong kind (and the use of home micros.) might actually do harm and, by implication, prejudice a student's chances of entering higher education:

> "...it is no good just providing schools with microcomputers. This will merely produce a generation of poor BASIC programmers. Universities in fact are having to give remedial education to entrants with 'A' level computer science. Uncorrected, the explosion in home computing with its 1950's and 60's programming style will make this problem even worse." (Alvey Report, page 62)

Many of the criticisms levelled at Computer Studies as a school subject could be applied equally well to other subjects. A number of the subjects shown in the "top 12" of Table 9 contain large sections which are hardly vocationally relevant and in some cases are barely educationally worthwhile. In addition few provide an adequate preparation for higher education and, in any case, is this their function? Why should Computer Studies be singled out from the mainstream secondary curriculum for cross-examination on its educational value and vocational relevance?

This is an issue which cannot be explored fully here. Perhaps a more telling indictment of Computer Studies is that its dominance has hindered the spread of computer education across the curriculum (examined in the light of empirical evidence in Chapter 5.

THE MICROELECTRONICS EDUCATION PROGRAMME (MEP) AND ITS "SUCCESSOR"

Alongside the almost exponential growth of Computer Studies there lay a second initiative which, in some sense, fought against that growth. The Microelectronics Education Programme (MEP), which ran from 1980 to 1986, was funded by the Department of Education and Science (DES) to a total budget of £23 million. One of the MEP's major aims was to encourage the use of computers as aids to teaching and learning ACROSS the school curriculum.

How far this aim has been achieved is not fully assessed here although the data in Chapter 5 provide some initial answers. Indeed the work of the MEP has never been fully evaluated although an HMI report has commented critically on certain aspects of its work (DES, 1987).

In primary education two studies in 1986 indicated that despite DES and DTI funding, with MEP encouragement, computer use in primary schools is not widespread and is rarely integrated into "good classroom practice". (Bleach 1987; Ellam & Wellington, 1987). Ellam and Wellington (1987) suggest that the "human factor" in introducing educational computing is often neglected, with an over-concentration on providing hardware and software. The DTI initiative to provide a £3.5 million subsidy for schools to purchase software did little to overcome human barriers to innovation. Following the termination of the MEP in 1986 the Microelectronics Support Unit (MeSU) was set up, based in the Science Park at the University of Warwick. It took over some of the work of MEP, although it can hardly be called its successor. The influence of MeSU has yet to emerge - once again, no formative evaluation is being carried out.

COMPUTER EDUCATION IN SECONDARY SCHOOLS: EVOLUTION AND ITS OBSTACLES

At secondary level, the main deviation from Computer Studies as an examination subject has been to provide 'Computer Appreciation' courses for ALL pupils, often at second or third year level. The surveys discussed in Chapters 5 and 6 show that this is now prevalent. However, a further stage (valued so highly by MEP) is confronted by obstacles both physical and mental. This is the stage, summarised in Table 10, of introducing computers across the curriculum into separate subjects e.g. computer-assisted learning (CAL) across the secondary curriculum. The physical obstacle, of course, has been the creation of "computer rooms" having anything between 10 and 20 computers and often part of the domain of the Computer Studies and Maths teachers.

Therein also lies the mental obstacle. Computers are widely seen, with some notable exceptions, as the province of the Maths/Computer Studies boffins, kept under lock and key in a computer room which often must be booked well in advance, and in many cases contains micros. linked or networked together. This prevents their "physical diffusion" into the fabric of the school, and their "mental diffusion" into the curriculum planning and classroom practice of other teachers. Evidence on this issue, and further discussion, is given in Chapter 5.

An additional problem has been the lack of technical support. If computers are to diffuse through a school into the rooms and practices of a wide range of teachers, technical assistance is needed. This may be provided, in exceptional schools, by the dedicated and overworked "computer teacher" - but in the majority of cases the SAFE OPTION is taken. Micros. remain in the computer room under a watchful eye away from "the incompetence at large".

The alternative is for the school "computer teacher" to act as a support technician to teachers in other subjects. This is yet another role for the teacher in charge of IT. As Table 10 indicates, that person's role has evolved from a SUBJECT PIONEER in developing, learning and teaching a totally new subject (stage 1), to a PROVIDER of IN-SERVICE TRAINING. For IT education to enter the third stage, that teacher is also forced to provide technical support for other staff in a range of subjects, in addition to providing further in-service training, and in some cases suggesting and evaluating suitable software across the curriculum. This triple role of technician, in-service training and software provider cannot be sustained by one individual unless he or she is given the time and freedom to do it. Without the provision of co-ordination and support for IT education, stage 5 of Table 10 is unlikely to be attained.

An important theme of this inquiry is to consider the diffusion of IT education and the rationale behind it. Table 10 provides a crude model for considering the development of computer education in secondary schools by suggesting various stages. The model will be referred to at different points subsequently, particularly in considering how IT education can best serve employment.

The National Curriculum

In 1987 legislation was introduced to provide a National Curriculum for all maintained schools in England and Wales. The position of IT in the proposed framework is not totally clear. On the one hand the famous red document issued in 1987 (DES, 1987) argued that a number of subjects or themes such as health education and the use of information technology can be taught through "other subjects", especially the foundation subjects. Thus IT can be "accommodated within the curriculum but without crowding out the essential subjects". On the other hand however, no statement on the national curriculum has ruled out the possibility of Computer Studies or Information Technology being included as an "additional subject" for GCSE.

It thus appears that the National Curriculum may not act as a significant restraint on the evolution of information technology in school education. Allowance seems to have been made for both the vertical and the horizontal approaches to IT in the curriculum. However, the way that the national curriculum develops and its interpretation "on the ground" remain to be seen.

THE TECHNICAL AND VOCATIONAL EDUCATION INITIATIVE (TVEI) AND THE YOUTH TRAINING SCHEME (YTS)

As already noted, an implicit belief in the vocational significance of information technology deeply affected both the thinking and the publicity associated with these two key innovations in vocational education.

YTS

Computer literacy, or IT literacy, was given a key position in YTS with its identification as one of the "Core Skills" in the YTS programme. All YTS trainees therefore receive some grounding in COMPUTER LITERACY although the interpretation of that phrase appears to vary widely (Bailey, 1986). In addition, a large number of young people (approximately 6000) on YTS are engaged in training at the INFORMATION TECHNOLOGY CENTRES (ITeCs) around the country. The first ITeC was launched in Notting Dale, West London in 1979. When Kenneth Baker, then Minister for Industry, visited the centre in 1981 he was impressed enough to propose a national string of such centres from Scotland and Northumberland to West Wales and Devon. At present there are around 175 ITeCs with approximately 35-50 trainees in each. In Chapter 6 the training offered by these centres, their links with employers, and the destinations of their trainees is analysed more fully, in an attempt to evaluate Kenneth Baker's belief in 1981 that such centres would help bring Britain to the forefront in Information Technology.

TVEI and IT-related courses

TVEI was launched in schools in September 1983. Its aim was to improve the education of 14-18 year olds by making the curriculum more "relevant", more practical and more "real" (see Table 11).

As Table 11 shows one of the aims of TVEI was to monitor and assess its own development. As a result the initiative has undergone extensive evaluation since its inception in 1983. That evaluation cannot possibly be considered here - however, valuable data has been collected on courses relating to information technology and computing and is currently stored in the National TVEI Curriculum Database at Trent Polytechnic. Figures from that database have not yet been disseminated, but the TVEI unit have agreed to release the data on IT related courses shown in Table 12. There has been something of a proliferation of IT courses as a result of TVEI which is interesting in itself. In Welsh TVEI schools, for example, there was a total of 5 computer related courses available in all schools in 1984. In 1985 this number had grown to 11, including courses labelled 'Information Technology' for the first time (figures supplied by Don Phillips, Database Manager, TVEI Unit). The causes of this proliferation are open to speculation and further research but it may well have resulted from the number of teachers with an interest in IT who formed their own consortia to develop new courses as an alternative to the Computer Studies examination-led teaching described earlier.

Whatever the causes, one of the results of TVEI has been the wide choice of IT courses now being followed in TVEI schools, both by TVEI and non-TVEI pupils. The figures in Table 12 show firstly the number taking four of the courses entitled 'Information Technology'. As with the Computer Studies figures in Table 8, there has been a remarkable growth in numbers involved. However the gender division has been nowhere near as marked in the case of TVEI schools. Although girls accounted for only 36% of TVEI pupils taking 'information technology' courses in 1984, by 1986 their numbers were almost equal to the number of boys. This number compares favourably (for the TVEI programme and its aims) with a percentage of girls at 32% of the total entry to Computer Studies examinations in 1984.

Thus TVEI data indicate that gender divisions in IT amongst pupils involved in the initiative are perhaps less serious than those evident amongst pupils taking Computer Studies examinations. An even more interesting pattern has emerged in the data on IT courses in TVEI schools which are clearly related (by their very label) to business studies, office practice and administration. Table 12 shows the numbers nationally taking courses labelled 'Business Studies and Information Technology'. Again, numbers have grown rapidly, but girls have continued to markedly outnumber boys. Similarly, figures on courses labelled 'IT and Office Studies' and 'IT and Administrative Practice' are available for 1986 which show the same bias. In the former, girls provided 77% of the total (admittedly only 47 TVEI pupils in all); in the latter girls made up 68% of the number.

These figures lead to interesting reflections on the work of the Technical and Vocational Education Initiative with respect to both IT education and to the gender issue. They provide an interesting contrast to the figures discussed earlier on Computer Studies. These issues will be explored further in the light of the empirical work reported on IT education in Schools, the curriculum of the ITeCs and its gender divisions, and the study of IT in employment.

Both TVEI and YTS are administered by the Manpower Services Commission. The relation of both initiatives to the world of employment and the needs of employers is considered in subsequent chapters in the light of the evidence presented in Chapters 5-11.

FURTHER AND HIGHER EDUCATION

It is an impossible task to summarise the important features of information technology in further and higher education in one section of one chapter. What follows therefore, is simply an outline of the main features of its development as they relate to the study of employers' needs in IT presented in Chapters 8-11.

Further Education

A wide range of courses relating to IT are currently offered in further education. As stated earlier, YTS courses involve computer literacy as part of a common core, and these courses are widely provided by colleges of further education. In addition, further education provides courses leading to BTEC (Business & Technical Education Council) qualifications, City and Guilds, and RSA (Royal Society of Arts) qualifications, many of which are wholly or partly involved with information technology. Other important qualifications are Higher and Ordinary National Diploma Courses (HNC and ONC). Several of these qualifications are specifically mentioned in the empirical survey of employers discussed in Chapters 8, 9, 10 & 11.

Higher Education

In Universities, graduates with degrees in INFORMATION TECHNOLOGY have yet to be produced, although the University of Salford launched a new degree with that name in 1986. A small number of polytechnics already offer degree courses in Information Technology.

Statistics are available on the output of graduates in "IT related subjects". However, the interpretation of that phrase is open to debate since so many traditional subjects (from the humanities and the sciences) do relate to IT. The interpretation given by the Institute of Manpower Studies is used in Tables 13A and 13B, which show the recent trends in graduate outputs from Universities and from Polytechnics.

A Government initiative in 1982 increased the number of places on first degree, higher diploma and higher certificate courses relating to information technology. The initiative also led to new one-year post-graduate conversion courses for 'good' graduates in non-IT subjects to become IT specialists in a relatively short time. The numbers of students graduating from these courses has now increased to over 800 per year. According to the Institute of Manpower Studies (IMS) Reports these graduate conversion courses have been well received by IT employers (Connor, 1985).

AN OVERVIEW OF IT EDUCATION

Table 13 provides a summary of the main landmarks relating to information technology in education and training. It is clear that a number of significant initiatives have been centrally launched and funded since 1980. What is not clear, however, is that any link or co-ordination exists BETWEEN the various schemes and initiatives.

Certainly, there is no guiding pattern or coherent picture of IT education from school level through to further and higher education. The ITeCs, for example, appear to be operating largely in isolation from school education on the one hand, and higher education on the other. Similarly, trends in school IT education bear little relation to higher education and in some cases appear to conflict with it.

The picture which emerges therefore is one of ISLANDS OF IT EDUCATION with few bridges between them. This isolation may have serious implications in, for example, higher education in the future if it seeks to expand the number of places available in IT-related subjects.

The relation of these islands to the world of employment is the theme in subsequent chapters where one of the central questions is considered: How can Britain's education and training systems best provide the human resources needed to develop both our IT industry and the use of IT in industry?

The issues introduced in this chapter are intended to provide a framework for the evidence about to be presented - these issues will be discussed fully in the light of that evidence, from both education and employers.

PART TWO: INFORMATION TECHNOLOGY EDUCATION IN SCHOOLS AND YOUTH TRAINING: EMPIRICAL ENQUIRY

CHAPTER 5

INFORMATION TECHNOLOGY IN SCHOOL EDUCATION

PART A: INTERVIEWS AND OBSERVATIONS

INTRODUCTION

Much of the work described in this section of chapter 5 was carried out during the TVEI-related in-service training (TRIST) project introduced in Chapter 1. Three teachers were seconded to that project, which was directed by the author and funded by MSC. The project team set out to gain a first-hand insight into two specific areas of IT education and training: Firstly, school education from 14 onwards and principally the growing influence of TVEI; secondly, the Youth Training Scheme and in particular the nature and influence of the Information Technology Centres (ITeCs). The latter inquiry is described in full in chapter 6. The first part of the inquiry into school education, which was enriched by the important perspectives of the teachers involved in the TRIST project, is detailed below.

INTERVIEWS AND OBSERVATIONS: KEY ISSUES AND APPROACH ADOPTED

It was felt that no realistic recommendations for future use of computers in schools can be made without a thorough investigation of the ways in which they are used at present. The picture that emerges from such an investigation could then be compared with the apparent needs of employers, and recommendations for future development made accordingly. With this ultimate end in mind, a decision was made to investigate certain aspects of the use of computers in British secondary schools.

In deliberating on the methods to be used, a number of possibilities were considered. Detailed case-studies of a small number of schools, perhaps along the interesting ethnographic lines of Turkle (1984), could have been pursued. At the other extreme a large scale national postal survey was considered as a means of gaining a general overview of computer use. This latter course had been followed by the DES (1986) and Welsh Office (1987) surveys of microcomputer use and it was felt that these should be used as a comparison, rather than attempting to replicate their findings. The fascinating ethnography of Turkle (1984) could not be followed due to the inevitable constraints of time and resources - her study lasted for a period of six years. It was therefore decided to carry out as many interviews and observations as possible in a range of schools in Britain within the existing limitations. These interviews and observations (reported in Chapter 5A) were then used as a basis for a form of electronic questionnaire sent to over 1000 schools which is described in the second part of this chapter.

The teacher fellows were actively engaged in the interviews and observations described in this part of Chapter 5 and therefore were involved in preliminary design of the inquiry.

Issues Examined

After lengthy discussion amongst the project team it was decided to cover the following areas and issues during interviews:

1. The extent to which schools have equipped themselves with computers and associated hardware. This would shed light on the degree of access that a typical pupil (and a typical member of staff) might have to computer equipment.
2. The background and experience of the teachers involved in the provision of computer-related courses was considered to be an important aspect for study as this might give an insight into the extent to which teachers are partially redeployed from particular areas of the curriculum into the computer-related area. The quality of in-service training for teachers moving into the IT area is clearly another factor affecting the provision of courses within it.
3. The nature of computer-related courses currently offered in secondary schools is a large field. Broadly, the aim was to discover the extent to which resources are used for examination and non-examination courses specifically in the knowledge and applications of computing. Do schools use their computing resources for all pupils to a fairly elementary level or for a selected few to a high level? In fact it was expected that many schools would adopt a combination of these two extremes.
4. The actual content of the courses was also investigated, partly during interview and partly by collecting and studying documentation from a variety of sources e.g. schools, exam. Boards, consortia, organisations.
5. In addition the interviews set out to explore the extent to which computer assisted learning (as opposed to courses in computing) was used across the school curriculum. (This issue was followed

up in the electronic survey.) The model of the IT curriculum shown in Table 10 of Chapter 4 provided a useful framework in considering issues 3, 4 and 5.

6. Finally, the perceptions held by teachers and pupils of the vocational significance of computers in education and the effect that this has on pupil motivation, was felt to be a key issue.

Interview Schedule

A "schedule" was designed to cover the following broad areas in interviewing teachers and making observations:

1) Details of the school
2) Resources
   a) The number and details of teachers involved with computers in the classroom
   b) The school's hardware
   c) The school's software
   d) Assistance from non-teaching staff and pupils
3) The ways in which the resources are used - the approach to computing in the curriculum
4) The perceived vocational significance of computers in education
5) For TVEI schools, the perceived effect of the TVEI philosophy on the rest of the curriculum.

This schedule was intended to be flexible so that it facilitated an open discussion. A mere question and answer session was avoided.

There was no agreed schedule for interviews with pupils. Interviews with pupils proved to be difficult to arrange and even more difficult to record, although some measure of success was achieved.

In general, schools were very willing to contribute to the inquiry. In many cases the interviews were conducted with more than one teacher present. These were felt to be more worthwhile than interviews conducted with just one member of staff as the interviewees often generated discussion without the prompts of the interviewer. The task of the interviewer in such cases was to ensure that the discussion followed the agreed schedule as closely as possible.

Each interview lasted for a minimum of 45 minutes and was recorded on cassette tape. Each researcher on the TRIST project was asked to produce a word-processed report of around 1000 words based on the interview. He tried to ensure that each report contained an agreed minimum of information on the use of computers in the school. In addition, he used his own judgement to select quotations from the interview that he felt particularly illustrated the major points. The report was then sent to the interviewee(s) for consideration. Many responded to requests for amendment, completion and further comment. The tapes themselves and the unabridged transcripts are available for verification (Stenhouse, 1982).

The researcher endeavoured to collect from each school as much relevant written documentation as possible to complete an understanding of the pattern and extent of computer use.
Such documentation included papers on learning objectives, examination syllabuses and entries in school handbooks.

In all, eighteen comprehensive schools were visited in different parts of England and Wales.

The limitations of using only interviews quickly became apparent. Significant statistical data could not be obtained on, for example, the number of pupils involved in the various computer courses and the number of periods per year spent on such courses. It was also realised that the number of schools visited would be small, due to constraints of time and money. In addition, the interview sample consisted almost exclusively of TVEI schools. Although such schools were interesting in that they had been given funds to develop vocational courses involving computers in particular, they formed such a small proportion of the total number of secondary schools at that time.

To remedy this *in the time that was available it* was decided to also conduct an electronic survey of a large number of schools (see Part B of this chapter).

SCHOOL COURSES OFFERED IN THE COMPUTING AREA

Before discussing the results of the school survey a short description is provided of courses related to IT which have been offered in secondary schools, in order to give the results more meaning and context.

Computer Studies

Computer Studies to GCE O level and CSE were available in almost all secondary schools in 1986 and 1987. Computer Studies typically involved the learning of BASIC and the completion of a project using this programming language. This is generally the only hands-on experience that candidates for O level and CSE were required to have. Typically, assessment in programming constitutes 30% of the total mark. The remaining 70% was assessed by written examination on the knowledge of the ways in which the digital computer stores and processes data, associated hardware, the history of computers, their applications, and their social and economic impact.

The new GCSE Computer Studies examinations became available in 1988. As with all GCSEs, they replace all existing O level, CSE and joint O level/CSE examinations. The minimum assessment objectives for the GCSE Computer Studies courses differ from those for O level and CSE in a number of important respects. One new emphasis is on the principles of problem solving by computer applications in a variety of practical situations. This should involve the running of packages and may involve the writing of software, but it is recognised that an overt emphasis on programming skills is misplaced. Another important aspect is the insistence that the computer should be used only for the performance of tasks that would not be better performed without the use of computers. Assessment by timed written examination may constitute 60% of the total mark. The remaining 40% will be an assessment of an extended practical project.

Information Technology

There are currently more than a dozen syllabuses in IT that were approved by examining groups for joint O level/CSE in 1987. One such syllabus covers datafiles, videotex, spreadsheets, word-processing, communications, graphics and the information society. It is assessed by timed written examinations that constitute 65% of the total mark. Pupils concentrate in greater depth on one chosen area in the form of a project. This project is assessed both in the form of a written report and a formal verbal presentation, and constitutes the remaining 35% of the total mark.

One problem in the preparation of GCSE Information Technology courses is that they should be sufficiently distinct from GCSE Computer Studies to warrant a syllabus in their own right and still include a sufficient body of knowledge and require candidates to demonstrate a sufficient range of skills and understanding. A possible future development is that the national criteria for GCSE Computer Studies will be revised to accommodate the aspirations of those who seek more skills-based courses. It may then be renamed GCSE Computing.

The Royal Society of Arts Computer Literacy and Information Technology Stage 1 examination was introduced in September 1984 and had attracted 25 000 entries by 1986, many of which come from secondary schools. Candidates must demonstrate knowledge of and skills in packages for word-processing, a spreadsheet, a database, videotex, business/accounting and graphics/plotting. They must also be able to start up a computer system, load a program and data and close the system down, use an input device, a printer, a disc or tape storage system and a backup system and use a computer to communicate information. A Stage 2 course has been piloted from September 1986.

Computer Awareness

Many schools have now realised the effect of introducing computer education solely in the option choices for their fourth and fifth years. It excludes the majority of pupils from the acquisition of knowledge of and skills in computing although they are likely to encounter computers at some stage in their lives if they have not already done so at home. This exclusion means that for the majority of pupils computing is surrounded by a mystique. One response to this situation was the introduction of computer awareness courses on a one period per week basis to all pupils in a particular school year group. A typical computer awareness course has modules in information handling, keyboarding, stock control, word-processing and telecommunications.

Using a slightly different approach, one London school introduced computer education as part of its pastoral curriculum. Over five years each pupil has a total of 28 one hour lessons covering computer aided design, word-processing, the computer as a learning aid, computer models, electronic music and databases (details from Holland Park Comprehensive School, London, W.8).

EVIDENCE FROM THE INTERVIEWS

The patterns emerging from the wealth of information collected in the sample of schools can best be presented under a number of headings:

1. Physical Restraints on Computing in the Curriculum

At least three-quarters of the interviewees identified one or more of the following problems:

1) The need for and the cost of adequate security limits the size and location of the computer room(s).

2) There is a lack of storage space for course materials and pupils' work.

3) There is a lack of space in the computer room(s) for small group work.

4) There are difficulties with the transport of computer equipment around the school due to the size of the campus and/or the existence of stairways.

2. Teachers

The number of Computer Studies/IT teachers in the schools varied considerably. In one school with 1450 pupils there was only one computing teacher and yet in another with 1280 pupils eleven were involved.

The majority of the teachers in the computing domain had a background in mathematics. Of the others the most common backgrounds were in geography and science.

The number of male teachers in the computing domain was four times the number of female teachers. This appears to be a reflection of the domination of mathematics teachers in computing.

Almost all of the teachers were part-time in computing. This was felt to be a benefit in that this is likely to encourage the spread of computer use into other subject areas.

A secondary school visited in Bradford was one full-time teacher short in the computing area at the time of the survey. When the post was advertised at Scale 2 there were no applicants. When it was advertised at Scale 3 there were no SUITABLE applicants. "Computer specialists can earn far more money in industry than in teaching" was given as the proposed cause of the lack of interest.

3. Staff Development and In-Service Training

Only those few interviewees with previous industrial experience in computing found the transition to teaching computing easy. In-service training of teachers has taken place with funds from the Department of Trade and Industry, The Manpower Services Commission and the Department of Education and Science. In spite of this teachers felt that the amount and quality of training were insufficient. One teacher had only attended a one week course. Another had attended six evening sessions and a couple of morning sessions per half term in the first year of a TVEI scheme. In addition, this teacher had attended an O level Computer Studies course in the school holidays.

Most training takes place through internal help at lunchtime and after school. This seems to be the only option.

> "There is a distinct lack of good courses ... In fact, I don't know of any. I've been on a Computer Studies course and it's been a total waste of time ... We do all the INSET (in-service training) ourselves in school at lunchtimes and I can't see a reasonable alternative to that. If you go on a course for a week the pupils are missing that entire week's lessons ... It's a case of priorities, isn't it?"

One teacher who had a background of computing in industry complained:

> "The situation is absolutely abysmal. There is no support whatsoever. The best support I want is time. Personally, I can train most people in this place but I haven't got the time to do it. I have done training in the summer holidays. Teachers attended in their own free time against the unions' advice.... What we want is time for teachers to sit down and train each other, to bounce ideas off each other... There are people in the TVEI scheme in other schools in Barnsley who have no background (in IT) at all. They've just been given the thing to do. I think they are very, very brave."

A teacher in the same authority with no previous experience of IT commented:

> "In the IT committee (a consortium committee of people teaching IT) we found we were discussing plans for lessons when we didn't have a clue what the subject matter was about."

One teacher stressed the need for software packages with good documentation and supporting materials.

> "I think, particularly when we are screaming out for INSET in this area, the packages used must reflect ... teachers' competence, which is very low."

Many teachers have taught themselves, often having to battle with badly written manuals. In-service training seems to have been supplied too late as one teacher pointed out *with feeling:*

> "It still rankles a bit that there was so little preparation for TVEI. I have a document which was sent out before the whole thing started which said something about the considerable in-service training which would be supplied before the course started. I arrived at school at the beginning of the year and was told that I would be teaching IT and I didn't have the foggiest what it was. I think that was very bad and it should never have happened. Since then there has been a fair amount of in-service training supplied by the Technical College mostly and that has been very good."

However, the need for continuing in-service training is woefully apparent. The impression gained from the interviews is that funding authorities may be willing to provide the hardware but they UNDERESTIMATE the need for in-service training.

In its assessment of the total cost of new computer hardware, a firm in industry includes the cost of training its employees for maximum benefit. Education does not.

4. The Human Factor in Curriculum Innovation

Concern about the lack of consideration of the human factor in the development of TVEI was expressed in many of the interviews. This concern is best summed up by the following excerpt from a transcript:

> "I'm very pro this school but I'm very anti most of the effort thats gone into making TVEI work in the school. Lack of communication is the main fault. I as a TVEI teacher don't really know what's going on. I find out more about TVEI from the kids. We seem to have lacked communication at senior management level. Perhaps this is because of the speed of its introduction, there was no planning. I'm sure in .... it was just a case of grabbing £5 million and running. We need "good will" injecting into the system and perhaps £1 million spent on teacher time rather than hardware. If we could appoint co-ordinators on half timetable to give them time to talk to people. Communication is what's lacking totally."

There is evidence that some of the TVEI philosophy has not been put into practice:

> "Theoretically there is space for one-to-one counselling ... but in practice we spend so much time trying to plan this course, which we've never done before ... They should be counselled by me and I've offered for this year's 4th year to interview them as well regarding their options but it hasn't actually come about yet. As liaison officer I'm supposed to be allowed four periods paid for by TVEI in which to do the counselling. Because of timetabling problems I haven't had any so far. So all the TVEI work I do in my free time, in my free periods."

Pupils in one school commented that IT homework was only sometimes marked. The teacher's written reply highlighted the extent to which she had taken on courses that required considerable preparation:

> "I am afraid I have to accept this comment ... I am afraid I have had to give a disproportionate amount of my time to IT due to it being my first time at it ... In addition to the eight IT lessons I have had five Industrial Studies and two 6th form General Studies IT, all of which were new courses this year."

It is a credit to the commitment of many teachers that TVEI has had some measure of success, particularly in its effect on pupil motivation.

5. TVEI and Pupil Motivation

The following extract from an interview shows how well pupils have taken to the IT syllabus in Stevenage which was drawn up by the Hertfordshire TVEI core staff.

> Q: "Are you broadly in agreement with its aims and objectives?"
>
> "Yes, very much so. It's one of the better syllabuses ."
>
> Q: "What sort of reaction do you get from the pupils? How do they perceive the subject?"
>
> "I think because there's a different type of teaching ... style that most of them ... it's very hard for me to say. I enjoy four lessons with them. They seem to do a lot of work, they seem to enjoy it. There are no problems, no discipline problems."

Another teacher was of the same opinion:

> Q: "How has TVEI affected your teaching style?"
>
> PB: "Wonderfully. No blackboard. No chalk. More relaxed ... Zero discipline problems. The great involvement of the students ..."

A Clwyd teacher reports the same:

> "For me it (TVEI) has gone from strength to strength in this school. The children are working like hell now. They are very highly motivated. They have astounded me with the input they have put into their work."

The effects of an improved learning environment on pupils' attitude and achievement are clearly seen in this extract:

> "We've got £15,000 worth of equipment and two teachers with 23 children in the best decorated room in the school, and some of the others are very shabby by comparison. The TVEI kids know this was done specifically for them and that counts for something especially with the lower ability kids who usually get the rough end of the stick. Compare that to one teacher in a tatty shambles of a room sharing dog-eared textbooks with 30 kids. It's not surprising that we (in TVEI) get better results and better motivation."

The inescapable conclusion here is that a similar injection of funds into the fabric of schools would lead to the improved motivation and achievement of all pupils.

6. Vocational Relevance

Only one interviewee rated the vocational relevance of an IT course very highly. Others gave more guarded responses. One Yorkshire teacher commented that pupils are unlikely at present to encounter much IT in local firms and that the vocational significance of IT education will only be realised when IT spreads in local industry.

It must not always be assumed that teachers actually know much about how IT is used in industry. In one school in Clwyd there was a strong feeling that staff should have had the opportunity to see for themselves the uses of computers in industry and commerce. On the other hand one teacher warned of the danger of training specifically for industry:

> "If you are talking about preparing them for the world of work there are two problems there. One, we've got very little idea what is used outside and two, whatever we teach is liable to be obsolete by the time they leave."

The vocational significance of IT education was questioned by more than one teacher. For example:

> Q: "Do you see IT as a vocational course?"
>
> "No, awareness. That's all I try to achieve. I think that any industry would train from scratch. I'm not sure that there's any vocational value in it at all."
>
> Q: "Do the pupils see it as vocational?
>
> "I think some of them do and that frightens me because they think they are learning something about computers when they are (in fact) learning more about some of the things that computers can do, and the things we can show them on the toys that we actually use is limited."

This teacher suggested in a written comment that pupils may be misled when choosing courses at options time by the label 'vocational'.

One teacher felt his role was to teach transferable skills for possible jobs:

> Q: "To what extent are you teaching them more than they actually will need to know when they have a job?"
>
> PB: "Oh yes, I'm sure I am."
>
> Q: "How can you justify that?"
>
> PB: "I don't think I need to justify that in terms of them getting a job. I think if they're interested and they're using their brain then its preparing them for a possible job, but if they don't use it then there's nothing lost, ... and I know if they did come to a machine which they hadn't seen before they would have a good idea how to figure out how to use it from the confidence they gain here."

In general, interviewees were not persuaded by arguments for the vocational significance of IT education.

7. Computer Awareness for All

In general, the schools' resources do not allow the implementation of one year computer awareness courses for all pupils in a year group and computing courses to public examination level. If computer awareness courses are run at all, then the most likely pattern is for groups to be extracted from other subjects.

There was concern that computer awareness should not be isolated from the rest of the curriculum:

> "We hope to adopt a modular approach (in the new 1st year course) with modules relating to work done in other departments, hopefully with their cooperation to make it more realistic. For example if we are teaching word processing it seems natural to liaise with the English Department. The Geography department has a week where they all "weather watch", where they collect data which they could then process using a database."

8. Integration of IT across the Curriculum

It was a generally agreed aim among the interviewees that IT should be diffused across the secondary curriculum. The equipment should be used as a learning resource in all subjects. The implementation of this aim is not easy, as one teacher pointed out:

> "One of the most infuriating things about the introduction of TVEI was the fact that we had all this work done and all this equipment put in and no-one but Computer Studies and Information Technology can get into this room to use it."
>
> Q: "Do you see a time in the future when the room will be free for people to book as an AV room or a lecture room might be?"
>
> "That is how I would like to see it develop. I think it's much more likely that we would end up with stations being put in other places. But that's what I'd hoped for. I didn't realise how difficult it would be."

This view was supported elsewhere:

> "Before TVEI I set myself the target that if I was still teaching IT in five years time then I had failed. We should not by then have to be teaching it, they (the pupils) should be meeting it every day in other contexts... That's the long term aim. TVEI has upset that because we are forced to teach IT for 60 hours."

In some cases IT is only available to TVEI students. Computer Studies is available to other pupils in the school, but not to the TVEI pupils. The school also offers A level Computer Science. With no technician and one full-time teacher short, expansion into any new areas is out of the question at present. However, plans exist both for a general IT course for all pupils and for the integration of IT into the general curriculum, but next year's courses will be the same as this year's.

One of the schools had used TVEI funds to directly benefit many more pupils than those who are nominally on the TVEI scheme. In the first three years there is a computer familiarity course and computer-assisted learning in Humanities and Science. In the upper school's modular scheme there is an Information Systems course which contributes to three combined 16+ syllabuses.

In one school the emphasis was on the diffusion of IT across the curriculum but a vertical strand (see Chapter 4 Table 10) may continue:

> Q.: "To what extent is your approach horizontal .... or vertical?"
>
> "Both elements, but obviously the stronger element is going to be horizontal. Greater emphasis, greater priority is placed there. In terms of the vertical then we're looking towards keyboard communication as the vital contribution for TVEI students rather than the IT content as it exists at the moment ... Also we did run Information Technology City & Guilds Foundation but we no longer run that .... One of the main reasons for dropping that vertical strand is that it ties up network rooms and is slowing down the possibilities of moving in the general curriculum area. So in general priority is given to making use of the computers ... as a tool in order to achieve the educational aims and objectives in other subject areas. But if the vertical strand can continue not to the detriment of the horizontal, then there's no reason why the vertical strand ... can't continue also".

In another school too the aim is to integrate IT into other subjects:

> "That's the way it's going at the moment. I can't see information technology expanding as such, as a subject. I don't really want it to. In fact, being blunt, when TVEI finishes then I hope the information technology element will also die, so that it would spread to be a part of other departments."

Evidence of the use of IT in other subjects was provided by several teachers. For example, in one school the English Department teaches word-processing, History and Geography use spreadsheets and simulations, and Economics does simulations and database work.

One teacher proposed the idea of a "roving computing consultant":

"I suppose in the long run IT has got to just ... fold up and be absorbed by computer use in all other departments. What we do at the moment could be done in ... other departments like the ... graphic design could be in the art department, spreadsheet could go into economics, Write could go into English. We've got Quest, the datafile program - that could go into geography or history. They could be spread out and used as resources just like a library."

Q: "Your role would change then. You would be a floater for all departments.

"PB: "Yes, they'd need one technical teacher to solve problems that the technicians can't handle and I would look forward to being something of that nature - an advisor and software tester."

However, in the move towards the integration of IT, computing staff must be careful with their relations with other staff.

"There are problems in spreading IT across the curriculum. We are just scale 2 maths teachers .. We have to be careful not to tread on too many toes or appear to be empire building, but we do have our 'moles' inside other departments."

In view of this comment, a deputy head might well be the most suitable person for the role of IT coordinator.

In one school, in addition to the TVEI IT course, all other pupils have IT as part of their general education. Plans are being actively pursued to phase out IT as separate lessons and to establish a resources centre for pupils to use IT facilities.

One school in the sample had adopted a "whole school" policy for IT. There is no specific IT course for TVEI pupils in years 4 and 5. There is no Computer Studies course either. At present there is a two-year course for years 2 and 3, run in conjunction with a communication skills course. These two courses take up 20% of the pupils' timetable. This system is likely to be phased out within three years as the topics covered by those courses become integrated into the mainstream curriculum.

In the majority of schools teachers are aiming to make computing resources available to all subjects. This may be inhibited by the existence of separate Computer Studies and Information Technology courses.

9. Priorities for the Future

The provision of more hardware was not seen as an immediate priority, although some felt that more good quality educational software was needed, especially for the RML machines.

The interviewees felt that future funding should concentrate on staff training and curriculum development. Work clearly needs to be carried out on the development of authority policies to ensure coherence between primary and secondary IT provision.

The issues raised in this part of the chapter are followed up in more detail in Chapter 5B, which reports on the survey carried out using the Times Network for Schools (TTNS).

PART B: ELECTRONIC SURVEY

This section of Chapter 5 describes the second part of the survey of computer use in secondary education. This was carried out through the Times Network for Schools (TTNS) using a form of electronic questionnaire. Although the nature of the sample inevitably means that the results are biased towards schools whose involvement in IT is above average, the survey does pose some interesting questions - particularly when its findings are compared and contrasted with those of the DES survey of 500 secondary schools at the end of 1985. The results of the survey indicate that Computer Studies is still dominant within the secondary curriculum, although many schools see the use of IT across the curriculum as their main goal. Some of the factors preventing the diffusion of IT into the areas of the secondary curriculum it has seldom reached are highlighted and discussed in the concluding section.

THE QUESTIONNAIRE

Having conducted visits and interviews in a small national sample of secondary schools, it was decided to collect specific information on a wider scale by using a questionnaire which would be distributed to a much larger sample.

The prior work carried out in interviews with teachers proved invaluable in framing the questionnaire. Thus the questionnaire followed the outline agreed upon in the interview schedule though it *concentrated* particularly on requests for numerical data. Schools were asked to provide the following information about their resources, their courses, their support, and their approach to IT in the curriculum:

1. Basic information on the school itself: number on roll, age range, number of staff, whether or not involved in TVEI.
2. Details of hardware: number and type of computers, networks (if any), distribution of computers, details of peripherals.
3. Staff support for IT: teaching staff, non-teaching assistance (if any) of different kinds.
4. Courses offered to pupils in computer education: for example, computer studies, computer awareness or information technology courses - either examined or non-examined.
5. School courses and curriculum areas using CAL or IT in any way.

The quesionnaire was designed so that this basic information could be supplied as easily as possible. In addition, in line with convention in questionnaire design, open ended questions were asked at the end. Thus the final part of the questionnaire allowed schools to describe in their own words any aspects of the use of computers in the classroom that had not been adequately covered previously. A large number of the schools which did respond provided much interesting information in this open section. (see Appendix 2 for a full list of questions and a sample reply.)

SAMPLING, DISTRIBUTION AND RESPONSE RATE

The aim was to reach as large a sample of schools as possible given the usual constraints of time and money.

For the distribution of the questionnaire the Times Network System (TTNS) was therefore chosen. This is, in some respects, an electronic mail service for education on which messages can be sent and received nationally.

TTNS electronic mail was chosen because it has a number of advantages over conventional post. Distribution lists were compiled, and then used to send the questionnaire to a large number of schools in a matter of seconds. This high speed method of distribution avoids the laborious task of addressing and franking envelopes. It is also far more cost-effective than conventional mail. All bundles of messages were sent for the cost of a short local phone call. Once the questionnaire had been read by the recipient an acknowledgement was given. This enables one to see who had read the questionnaire but not responded after a couple of weeks and might therefore need a polite reminder. Furthermore, a higher response rate was encouraged by swiftly answering any queries and comments from those who had received questionnaires.

The sample consisted of all the secondary schools that subscribe to TTNS. Thus the questionnaire was sent to 1010 maintained schools in England, Scotland and Wales. In 1985 there were 3745 maintained secondary schools in Great Britain. Thus 27% of all such schools were contacted. The sample also included 66 independent secondary schools.

Clearly this cannot be regarded as a simple random sample of all schools, since those subscribing to TTNS would more likely be 'computer orientated' schools, having more computer facilities and utilising them in various curriculum areas. Perhaps because of this, the results of the survey are interesting; they can be seen as being representative of the most computer orientated schools in the country and as such give an idea of the maximum levels of IT involvement in schools at the time of the survey.

The electronic message to schools consisted of an explanatory letter followed by the questionnaire. In the main, the respondant in each school produced a printout of the questionnaire, filled it in by hand and then sent it back by conventional post. A few respondants managed to enter the questionnaire into a word-processor. They then filled it in on the word-processor and sent the completed version back as a message on the electronic mail system. In the event, just over 100 schools fully completed and returned the questionnaire. Certain areas replied in far greater numbers than others with Derbyshire and Hampshire being particularly well represented. The regional differences in response rate are a second important reason why the results of the survey presented below should not be taken as representative of national computer use in secondary education.

The response rate of just over 10% may be considered rather disappointing. It may be a reflection of the design of the questionnaire, the completion of which might have proved too onerous a burden for busy school staff. It may also indicate that only a small number of schools actually make active use of TTNS despite their subscription to it. One further bias is worth stressing before the results of the questionnaire are summarised and discussed. It has already been suggested that the sample used in the survey was neither random nor representative - conclusions must therefore be drawn with caution. This situation is exacerbated by the fact that schools responding to the electronic survey are obviously likely to be those most involved and active in the use of IT in education.

It is worth re-emphasising that the figures about to be presented inevitably do not cover a complete cross-section of secondary schools in Britain. The figures from this survey will therefore be compared and contrasted at relevant points with the survey carried out by the DES in November 1985 (DES, 1986). Interestingly, their response rate from a postal questionnaire was 53% (i.e. a total of 265 schools). Their survey seems likely to present a more representative picture of computer education in secondary schools by covering a broader cross-section. However, it may well be the case that the schools responding to the DES survey were more actively involved in computer education than the proportion (47%) who did not.

SUMMARY OF THE RESPONSES RECEIVED

The schools

Sizes of the schools responding varied from 148 pupils to 1745, the mean being 860. The percentage of each type of school responding was as follows: in the 11-18 age range, 56.5%, in the 11-16 range, 43.5%.

There were 25 TVEI schools in the sample which were generally larger than non-TVEI. Their average number of pupils was 903 as opposed to 842. The mean staff:student ratio was 15.5 (15.7 for non-TVEI schools, 14.8 for TVEI schools; 16.0 for 11.16, 16.0 for 11-18), with all schools clustering round these figures.

Computers

Schools were asked to catalogue the existence, type and location of all their computers. TABLE 15 presents the breakdown according to brand of computer with, not surprisingly, the BBC computer dominating the market at the present time. The figure of 84% in Table 15 indicating the proportion of micros. which were BBC machines is a high one especially when compared with the 60% quoted by the DES survey.

Access to Computers

The average number of computers per school was 23 but this varied considerably (between 4 and 63) according to school size, degree of computer orientation and availability of funds, most notably in the form of TVEI support.

This contrasts with the average of 13.4 micros. per English secondary school quoted in the DES survey and 17 micros. per school in a later survey of Welsh schools carried out in February 1986 (Welsh Office, 1987).

The quantity of computers in a school was mainly related to the number of its pupils, but having taken that factor into account whether the school was involved in TVEI or not was also statistically significant. It was decided to use a convenient measure indicating (quantitatively only) the degree of access to a microcomputer which a school pupil could expect. This was defined simply as the ratio of the number of pupils to the number of computers, and labelled the "computer access factor" (used also in Ellam & Wellington, 1987). The computer access factor, CAF, (i.e. number of pupils per computer) in different schools varied considerably between 7 and 148, though 86% of schools fell in a band of between 20 and 70. The median CAF was 44; for TVEI schools it was 26, for non-TVEI, 47. Once again these figures contrast with the much higher figure of 60 secondary pupils per micro quoted in the DES survey (DES, 1986, Table 1).

Location of Computers in Schools

Table 16 describes the locations of computers around the school. Computing laboratories/computer studies rooms obviously dominate the locations, but the other sites are interesting and not always predictable.

Table 16 agrees closely with both the DES survey (Table 15) and the Welsh Office report (Table 33) which both show Computer Studies as the dominant department, though often in disguise as a sub-set of the Mathematics department.

Non-Teaching Assistance

All schools were asked to outline the assistance given to teachers by either non-teaching staff or pupils. By far the most common non-teaching assistance provided came from pupils - it seems that pupils are widely used for altering programs, copying discs, helping with networks, maintaining software libraries and many other tasks. There were very few schools with technicians having responsibility for IT, although some science technicians are used in this area. TABLE 17 provides a summary of the results.

Computer Courses in the Curriculum

One of the things that I wished to explore in the survey was the use of computers across the curriculum, particularly as this issue would be followed up in the later survey of employers and their requirements. 91% of the schools were providing examination courses with an essential computer element (e.g. Computer Science, Computer Studies). 78% of these were providing Computer Studies courses specifically for O/CSE exams. The mean number of pupils taking such courses was 34, about a quarter of the average year group size of 149. 30% of the schools were providing IT courses to exam standard, either alone or with Business Studies etc. Only 19% of these were to O/CSE level, the rest being for other, vocational exams, e.g. pre-BTEC, Pitmans WP, RSA etc.

89% of the schools ran non-examination courses incorporating an essential computer element. 72% of these ran computer awareness/applications/appreciation courses, often for forms lower down the school (49% of these courses were in Year 1).

CAL across the Curriculum

An area of particular interest was the extent of computer assisted learning (CAL) in other subjects across the curriculum. 67% of the schools reported that they were using CAL in this way. TABLE 18 presents the frequencies of subjects in which CAL took place in different stages of the secondary school from Years 1 to 6.

As expected, the traditional 'scientific' subjects showed a predominance in utilising CAL as a teaching tool, especially towards the upper end of the school. These figures show a close correspondence to other indicators of computer usage across the curriculum, e.g. the measure of computer sites in schools (see TABLE 16) and measures of the distribution of computer software across the curriculum (for example, Gilbert, L.A. (1985), p. 25).

CAL and Networking

Of the schools responding, 62% had networked computer systems of which the bulk (77%) were Econet Systems. One of my hypotheses regarding CAL was that schools with networking facilities were less likely to be using CAL across the curriculum. The evidence from the survey serves to support this hypothesis. The mean number of subjects using CAL for schools possessing networks was 1.8; for those NOT networked it was 2.1.

TABLE 19 shows that of the schools responding which had no network, 27% used CAL in four or more subjects while 73% of these "non-networked" schools used CAL in three or less than three subjects. Of the schools responding which did have networks, 21% used CAL in four or more subjects while 79% of these "networked" schools used CAL in three or less than three subjects. These figures do indicate therefore that the networked schools in this sample used computer-assisted-learning less widely than the non-networked schools.

The exact numbers of subjects using CAL from a minimum of 20 to a maximum of 8 are shown in TABLE 20, which is divided into schools with networks and schools without networks.

These findings are particularly interesting in the light of the fact that "networked" schools tend to have considerably more computers - on average 26.7 as against 17.6. However, the computers in "networked" schools are more clustered in computing laboratories, on average 16.9 as opposed to 10.9 in non-networked schools.

Evidence in this survey thus indicates that the diffusion of computers across the curriculum and the widespread use of CAL may be restricted by certain uses of networking. This evidence supports a hunch or feeling sometimes expressed in popular journals (for example, THE MICRO USER, October 1986, pp. 31-32, or Bishop, P. 1986) that networking microcomputers may be hampering the growth of IT in the curriculum. However, the intention here is not to imply that networks in themselves are a hindrance to the diffusion of CAL. Where properly used a reliable network can surely enhance the spread of CAL and IT across the curriculum by providing workstations around a school and also by providing powerful filing systems which might otherwise be unavailable.

GENERAL COMMENTS INDICATING TRENDS IN SCHOOL IT EDUCATION

All schools were invited to make general comments on their use of computers in education. A large number responded. Once again the complete collection of responses has been retained by the author for the purposes of verification or further study should anyone wish to explore these issues further.

The selection of comments below illustrates two general trends clearly visible in the schools' replies.

The first was the desire to move away from examination courses in computing towards more widespread use of CAL across the curriculum:

> "The use of computers/IT across other departments is still very much in its infancy in the school, but it is an aspect of the curriculum which we intend to develop over the next few years. From Autumn 1986 we will begin to use Prestel and TTNS."

To many schools, one of the greatest restrictions on the growth of CAL is the availability of hardware:

> "Computer equipment is used almost all the time. When not used for computing examination work other departments grab any available time."

> "As all machines (except one) are in the Computer Studies room which is used for 32 out of 40 periods there is little scope at the moment for CAL."

As a result, some schools felt that the only way to encourage CAL was to drop examination courses in computing:

> "We are dropping Computer Studies as an examinable subject - concentrating on IT, with a firm commitment to spread IT across the curriculum."

The latter comment indicates the second trend. Use of the term "information technology" (IT) and the presence of courses in IT rather than, say, computer studies or computer awareness appears to be increasing:

> "The curriculum of this school is to include a more structured approach to IT, allowing all pupils to become familiar with the computer as a tool. Hopefully more departments will have access to and make use of the computers within the school."

> "The realm of IT is on the verge of wider scale integration into the curriculum. Staff are willing to experiment with new ideas and examine their impact in the classroom."

In some schools the diffusion of IT across the curriculum was well under way:

> "Many departments now use IT to enrich their teaching, although these are not essential components of courses. These include: English, Maths., Languages, Biology, Chemistry, Physic, CDT, Home Science, History, Music, Geography, Careers, Business Studies."

Only one school in the entire survey appeared to have entered IT education from the opposite end. They had already adopted a "horizontal" i.e. cross-curricular, approach to computer education and were now considering a "vertical" approach:

> "Our philosophy has been very much in favour of computer education for all pupils rather than exam courses. We are now considering GCSE Computer Studies or RSA or Pitmans for less able older pupils to widen their option choices."

DISCUSSION

The aim of this part of Chapter 5 is primarily to present the main results of the Times Network survey in order to raise certain issues and to provide discussion. As stated earlier, it would be foolish to claim that generalisations can be made from such a small and biased sample. However, it seems to the author that certain trends and indicators do emerge from the survey - these are discussed briefly below under two headings.

School Courses

Examination courses in computing dominate IT education in schools. The subject "computer studies" has grown steadily in terms of examination entries (see Chapter 4). However, two clear trends emerge from the survey. Firstly, there are an increasing number of courses labelled "information technology" either being discussed by schools or recently introduced. Information Technology courses are available in a growing number of schools to all pupils, sometimes taking over from the less broad computer appreciation or computer awareness courses.

Secondly, the majority of schools see the introduction of computer assisted learning (CAL) across the whole school curriculum as the next stage in their development. Some already have CAL in a number of subjects (science and maths. most commonly - see Table 18.) Many others expressed the intention of introducing CAL across the school curriculum. The restraints on such curriculum development, however, were present in every school.

Restraints on IT in the curriculum

The most obvious constraint on the diffusion of CAL is the lack of computer hardware. Even in TVEI schools the average computer:pupil ratio (labelled the computer access factor) was 26:1. This low access factor is only a part of the problem - in a clear majority of schools (67% in the survey) most computers are located in computing labs. or computer studies rooms. The survey findings also indicate that the existence of networking is inversely related to the uptake of CAL across the curriculum (see TABLE 19).

Two further restraints emerging from the survey are the lack of technical or non-teaching support for IT staff, and the need for in-service education across the school staff. In almost every school surveyed and interviewed, teaching staff (many of whom were expending great time and energy in trying to spread IT across the curriculum) received no paid technical support. Many teachers used older pupils such as fifth and sixth formers, as unpaid assistants e.g. in copying discs, setting up hardware, troubleshooting etc.

TABLE 21 shows the average number of subjects using CAL in schools having technical assistance compared with the average number in schools without technical assistance for IT. The figures indicate that, in this sample at least, the spread of CAL across the curriculum is significantly higher in schools with non-teaching assistance for IT.

The problem of the spread of CAL and the use of IT in the curriculum was compounded by the lack of in-service training amongst other staff. The school IT person is often both a technical assistant and in-service trainer to other teachers.

A final impediment to the diffusion of IT may well be the background of the staff involved. The clear majority of teachers involved in IT had a background in mathematics. This may well result in the view, held by teachers and pupils, that the use of computers has something to do with mathematics. The persisting perception is that computers are number crunchers rather than information handlers. Additionally, the number of male teachers involved in IT was four times greater than the number of females. This may send similarly unwanted messages to other teachers, pupils and parents.

Method Employed

Chapter 5B has provided a summary of the information gathered on computing in secondary education using an electronic network. The methods used in the inquiry are considered to be as worthy of study as the results themselves.

The survey as reported here provides a case-study in the use of networks of this kind in collecting information. The work carried out indicates that response rates to questionnaires using electronic mail may not be high, although similarly low response rates are often associated with conventional questionnaires. The response rate may in part be due to the fact that many schools who subscribe to TTNS do not actively use it.

However, it does seem that a network of this kind can be a valuable tool in collecting general information on current practices and trends in education efficiently, quickly and relatively cheaply. As a method of inquiry the use of electronic networks certainly merits further study. Its potential in the future may increase as the incidence of networks, and more importantly people's familiarity with them, is extended.

Trends and Issues emerging in Chapter 5

A vast amount of data was collected on the use of IT in secondary school education, a selection of which has been analysed and reported above. Certain evidence bears directly upon the issue of the relation of education to employment in IT. For example, is the software and hardware employed of the right kind in establishing education-employment links? How do teachers perceive the vocational significance of IT education? The school situation is contrasted sharply with the "training" approach adopted by the Information Technology centres described in Chapter 6. Both approaches are later compared with the requirements of employers.

Certain trends are also emerging in school IT education which will later be compared with the perceived needs of employers in IT. Two examples mentioned above are the increase in courses labelled 'Information Technology', and the gradual but very slow diffusion of CAL across the curriculum. Again, the school approach from 14 onwards must be compared and contrasted with the apparently more pragmatic and vocational approach of the Youth Training Scheme and the ITeCs shown in Chapter 6. How do the contrasting approaches compare with the stated needs of employers in IT? Which approach is, in reality, of more vocational significance? These questions will be examined ultimately by comparing the evidence from education and training in IT from this chapter and Chapter 6 with the evidence on employers' perceived needs in IT described in later chapters.

CHAPTER 6

TRAINING IN THE INFORMATION TECHNOLOGY CENTRES

INTRODUCTION

In planning the Youth Training Scheme, the MSC made a positive decision to include an element of computing in the programme of every YTS trainee. It would be a vast undertaking to evaluate the content and effectiveness of the IT component of every YTS programme and, although such an evaluation might well be valuable and cost effective in view of the large amount of money spent on it, no full-scale evaluation has yet been undertaken.

However, the notion of 'computer literacy' underpinning the drive to instil an IT component into every training scheme has been critically analysed elsewhere, by a research student under my supervision (Bailey, 1986). That piece of research, although unpublished, provided a valuable general background to the more focussed inquiries described in this chapter.

The aim in these inquiries was to examine in detail one aspect of the YTS programme which was entirely directed at providing industry and employment with IT skills at a certain level. This programme was deliberately set up to solve some of the skill shortages in IT at non-advanced level by providing off-the-job training for young people in specially created centres.

It was felt that the programme was worth studying in detail for a number of reasons. Firstly the programme was almost entirely driven (although the subsequent report shows important exceptions at local level) by a belief in its vocational significance. Secondly, the programme was aimed initially at consumers at the older end of the 14-18 age group and therefore provides an important contrast with IT education at school level and especially with the IT components of TVEI schemes discussed earlier. Finally, the programme plays a vitally important part in education and training for employment, at non-advanced level. As will be seen, employers have played an active role in the programme in certain areas, though to a lesser extent in others. The programme provides an important case-study in training for employment in IT which can be evaluated fairly satisfactorily and also raises important general issues in examining the overall provision of education and training for IT in other areas and at other levels.

Much of the work carried out on the ITeCs was completed during the TRIST project already described with the aid of MSC support. Some of the interviews were carried out by teacher fellows under my direction. The postal survey described initially was carried out in conjunction with the interview study and the two should therefore be seen as complementary. The key issues to be examined emerged within the context of the whole inquiry and became more clearly focussed through explanatory interviews with ITeC staff which I conducted in the early stages. Those issues are described below.

THE ITeCs: BACKGROUND IN BRIEF

The ITeCs, (Information Technology Centres) were launched in 1981 by Mr. Kenneth Baker, then Minister for Information Technology. Initially the plans were for a network of 30 ITeCs to be established nationally, mainly in inner cities with high youth unemployment. Kenneth Baker had been impressed enough by his visit to the Notting Dale ITeC in 1979 to argue that a string of similar centres would help to advance IT in Britain. Funding for these came from the MSC (Manpower Services Commission) and the DTI (Department of Trade and Industry). There are now almost 180 ITeCs in operation and since 1983 they have been involved in YTS (the Youth Training Scheme) and funded under Mode B1 arrangements.

The Alvey Report, mentioned earlier, emphasised the shortage of skilled manpower in Britain's industry. The ITeC programme's objectives were to help alleviate this shortage at one particular level, that of the less academically qualified youngster. It is this explicit vocational function which prompted the decision to study them in some detail as part of the general inquiry. It should be noted however that the MSC and DTI appear to have differing objectives for the ITeCs. The Deloitte, Haskins and Sells report 'A Review of the Information Technology Centre (ITeC) Programme' (1985) lays out the objectives as follows:-

> "...ITeCs are asked to provide a complete programme of vocational preparation to conform to the YTS objective of providing a bridge between school and working life through a period of training and planned work experience, and to contribute to the overall balance of YTS provision in a local labour market area".(Para 36)

The Handbook for Information Technology Centres, (MSC 1985) adds:

> "a major purpose will be to give young people experience of a range of adaptable skills which will develop their potential and improve their prospects of finding permanent employment"(Para 1.11)

The report points out that these differing objectives "require different skills of operation and expect differing outcomes".(Para 39)

The translation of those objectives into practice is examined below in the light of the evidence gathered.

THE AIMS OF THE ITeC STUDY

It was clearly beyond the scope of this inquiry to study the nature and function of the IT component of the Youth Training scheme generally. But given the relatively small number of ITeCs it was seen as a realistic and worthwhile target to examine the training and education they provide within the overall context of the whole inquiry. This aspect of Youth Training could then be compared with other provision of IT education (at school and higher levels) and with the needs of employers in IT. The ITeCs had been set up to provide "a workforce with the new skills necessary for Britain to take a leading part in the technology revolution". (Sage and Smith, 1985, page 143). How far were they succeeding in this aim? Is this really the purpose of ITeCs, and the basis on which they should be evaluated?

After exploratory interviews and discussion it was decided to focus on the following main issues in studying the ITeCs:

1. Details of the ITeC itself: its equipment, resources, sponsors and staff-student ratio.
2. The policy on intake: numbers, selection criteria (if any), age-range.
3. The curriculum offered by the ITeC to trainees, including work experience.
4. The destinations of trainees on leaving the ITeC, and (where possible) a consideration of the relevance of their training to their employment.

5. The policy and views of staff in the ITeC on income generation and its relation to their training function.

6. The views of staff on the aims and purposes of an ITeC and its success in fulfilling the perceived role.

These issues, and others which arose spontaneously were covered (as far as possible) in both the postal survey and the interviews described below.

METHODS EMPLOYED

Contact with every ITeC in the country was made. Ultimately, staff in twenty four ITeCs were interviewed using a cassette tape recorder. No rigorous sampling method was used in selecting the 24 ITeCs visited. The sampling procedure could best be described as "purposive" (Cohen & Manion, 1985). Every effort was made to provide a geographic spread (to include the North, North East, Midlands, London, the South-East, South West and Wales), and to provide a mixture of urban and rural ITeCs in a range of employment environments. A transcript of the interview was returned to the ITeC for comment. A semi-structured approach to the interviews was taken, using only a broad outline. This allowed for a free discussion which often raised issues that had not been anticipated a priori. (Chapter 6B summarises the results of the interviews).

In conjunction with the interview study, and in parallel with it, all the ITeCs not selected for interview were sent a postal questionnaire (shown in Appendix 3). The information collected from the questionnaires is now summarised, in Chapter 6A.

PART A: TRAINING IN THE ITeCS: THE POSTAL SURVEY

Thirty-six fully completed and usable questionnaires were received from ITeCs. The low response rate perhaps reflects the fact that ITeCs appeared to have continual demands on them, from different sources, to provide information.

DETAILS OF THE ITECS THEMSELVES

Details on the sponsorship, year of establishment, numbers of trainees and intake policy of the ITeCs responding are given briefly below.

Many ITeCs had more than one sponsor. The distribution of sponsorship in the postal survey was: Industry 53%; Councils 72%; Charities 11%; Self Sponsored 11%; University Sponsored 4%.

The Year of Establishment of the ITeCs responding was as follows: 1979: 3%: 1982: 19%; 1983: 53%; 1984: 22%; 1985: 3%.

The Numbers of YTS trainees in each ITeC varied from 20 to 70 as follows: 20-30: 23%; 31-40: 31%; 41-50: 23%; 51-60: 4%; 60-70: 4%; more than 70:15%.

Selection of entrants was carried out using the following methods: Interview: 85%; Aptitude Test: 33%; Open Access: 7%.

Staffing

The industrial experience of ITeC staff is very extensive and diverse. Many managers and staff had a forces background, usually in administration and/or training.

The staff of the ITeCs had the following backgrounds and qualifications: Graduates: 63%; Industrial Experience: 81%; Youth Training Certificate: 19%; C & G 924: 10%.

The Staff/Student ratio in ITeCs contrasts sharply with the pupil/teacher ratio in schools - the trainee/staff ratio for ITeCs averaged out at 6.5:1.

Equipment

The number of computers (keyboards) compared with the number of trainees in the ITeCs gives a ratio of 0.94 keyboards to each trainee i.e. very nearly 1 computer to each student (c.f. the computer access factor in the schools survey).

The range of computers used in ITeCs is summarised in Figure 6 in order of priority - this provides an interesting comparison with the school survey, although the BBC microcomputer is again dominant despite its almost total absence in industry (see later comments from interviews).

Many ITeCs use a wide range of software. The most popular packages and the proportion of ITeCs using them are listed below: WORDSTAR Word processing: 85%; D/Base II and/or III: 85%; Supercalc (a spreadsheet): 70%; Lotus 123 (a spreadsheet): 67%.

The programming languages available for use were as follows: BASIC: 49%; COBOL: 22%; FORTRAN: 7%; Other languages (including LOGO,LISP, FORTH, ASSEMBLER, MACHINE CODE, L, C,Prolog): 26%.

Other equipment generally available in some but not all ITeCs is listed below:

AIM 65 Kit; Audio Typing equipment; Bar Code readers; Breadboards; CAD/CAM facilities; CNC Milling Machine; Counter/Timer; Eprom Programmer; FAX; Fibre Optic package; General Tools; Hero Robot; Light Pens; Logic Analysers; Logic trainers; Microfiche; Oscilloscopes; PCB etching equipment; Photocopiers; Power Supplies; Printers; Pulse Generation; Robot Arm; Signal Analysers, Signal Generators, Test Meters; Thermal Binder; Thorn EMI Sintec Multiframer; Typewriters (electric and manual); Videoframegrabber; Video digitiser; Weather Satellite Receiving Station.

The general impression gained was that ITeCs are extremely well equipped, even in comparison with TVEI schools.

INCOME GENERATION VERSUS TRAINING NEEDS

The initial funding by MSC and DTI was planned to decrease or cease altogether over a period requiring the ITeCs to generate their own revenue. Some already generate a large proportion of their revenue, others have to look for methods of generating revenue in the future. The two main areas of activity which generate income are the selling of training to industry and the community and the selling of services such as bureau services and repair services.

There is a great variation in the percentage of self-generated income across the ITeCs, but there is a general trend towards a larger proportion of self-generated income. A large number of ITeCs (85%-88%) generate income by offering training with the selling of services coming a very poor second. (The services offered and the general issue of income generation are discussed further in Chapter 6B.)

All the ITeCs were asked if the need to generate income had and would affect the training they were able to offer either positively or negatively. The majority felt that it would have a negative effect (52%) with a slightly smaller number commenting on its positive effect (48%).

Comments on Revenue Generation by ITeC Managers

The Deloitte, Haskins and Sells report states:-

> "The reasons given for the change (to generate revenue) are:- to encourage the provision of ITeC training facilities to other client groups: to meet an increasing need for replacement of worn out or obsolete capital equipment; and because of the beneficial impact on training. For example, good production and sales levels are encouraged because:
> a) they make the training environment more realistic
> b) trainees are given the discipline of working to deadlines and
> c) the production of goods and services provides a sense of achievement."

By comparison with the Deloitte suggestions the following selection of written comments on the positive, balanced and negative aspects of revenue generation given by ITeC staff is listed below:

1. Positive:

> "Positive in that training adults presents a challenge to staff and therefore improves their training skills; "Income generation enhances effective training"; "Positively. More appropriate work experience and contacts for our YTS trainees"; "Positively - Trainees benefit from expertise of staff as do external clients; plus real work projects"; "Positively by feeding in experience and courses for YTS".

2. Balanced:

"Bit of both. In theory positively, in practice dubious"; "Positively on clerical services, negatively when doing training other than YTS. Limitations on staff resources creates difficulties in maintaining adequate cover on our own class provision"; "Currently positively though it may change"; "At present the need to generate income benefits us but a large requirement in future will be a grave disadvantage".

3. **Negative:**

"...Negative in that less time is spent on YTS though not to a serious extent; also have management time taken up on obtaining outside work, co-ordinating it, timetabling etc."; "Negatively - Dilution of management and other staff resources"; "Negatively, during the transition period at least"; "Only slightly. Disruptive on staff time/effort - may provide work experience"; "Negatively at the rate required in year 3 unless we can make a success in years 1 and 2 with commercial activities"; "Negatively at present. Things don't change overnight in real systems. The MSC staffing and control policies were grossly inadequate prior to April 86 and will take 6 months minimum to equilibriate, assuming other restrictions are not practiced".

THE CURRICULUM OFFERED

There are normally three main areas of the curriculum:

a) Modern or electronic office

b) Computing

c) Electronics

However, not all ITeCs offer all three areas.

The Modern Office component included the following range of topics:

Accounting; Audio transcription; Bookkeeping; Databases; Filing; Integrated packages; Mailing; Order processing; Payroll; Receptionist/Telephonist Duties; Spreadsheets; Touch typing; Use of directories; Viewdata; Wordprocessing.

The courses offered in Computing cover training in the following areas:

Application; Database management; CBT; DTP; Graphics; Hardware Evaluation; Software Evaluation; Systems Analysis; CAD/CAM; Flowcharts; Teletext editing; Documentation.

In addition, programming was offered in the following languages:

BASIC, COBOL, PASCAL, PROLOG, FORTRAN, LOGO.

In electronics the courses offered covered training in the following areas:-

Use of text equipment; Design and assembly of analogue circuits; Design and assembly of digital cirtuits; PCB design and manufacture; Systems; Machine principles; Robotics; Microprocessor architecture; Networks; Interfacing; Fault diagnosis; Control systems; Engineering drawing; Machine code programming.

It should be noted that not all centres offered all of the above courses.

As well as the 'mainstream' courses many ITeCs gave training in Personal Development, Communication Skills, Health and Safety, First Aid, Interview Techniques and Marketing.

Some centres also invited external speakers into the ITeC and took trainees on residential courses, outdoor pursuits and adventure training.

PLACEMENTS WITH EMPLOYERS FOR WORK EXPERIENCE

An important contrast between school education and ITeC training is the central position of work placement in the latter.

The pattern of work experience varied tremendously. A sample of the variety is given below:-

"When and Where available"; "48 weeks in 2nd Year"; "Variable according to trainee"; "18 months with day release to ITeC"; "Day release to work plus 8 weeks"; "6 weeks in Year 1: 6 months in Year 2"; "9 months training, 6 months work", 3 months training, 6 months work"; "6 to 12 months in years 1 and 2"; "6 weeks Year 1; long term year 2"; "35 weeks Year 1; 45 weeks year 2"; "6 months year 1; 12 months year 2"; "3 days per week Year 1; 1 day per week year 2"; "4 to 6 weeks year 1; 12 months year 2"; "8 to 12 weeks year 1; 45 weeks year 2"; "15 to 18 months at 4 days per week".

Staff were asked whether they find any difficulty in finding placements now, and whether they expected difficulties in the next 2 years. 48% of those responding said that they found difficulties at present, with 37% saying they found no difficulty. In the next two years, 59% expected to find difficulty.

Some of the general comments by Managers on work placements are listed below:

"It is difficult finding sufficient who will train"; "I fear saturation of potential placements this year may cause problems in future"; "They are very hard to come by at the moment and even more difficult in future because of numbers and MSC regulations"; "No difficulty with constant canvassing (1/2 day per week of staff time)."; "More difficult to place males"; "Great difficulty in any skill area"; "Insufficient spare time to find placements"; "Cannot adequately monitor placements"; "Need extra staff, need to persuade employers to pay"; "Difficulty due to being a mainly rural area"; "Both computing and electronics will not be easy"; "Poor location away from industrial estates and commercial premises"; "Too many schemes, industry/ schools, asking for places"; "The number of companies prepared to participate is too small".

Certain issues arise here which will be followed up in Chapter 6B. For example, male trainees may be more difficult to place than females; two areas of the curriculum - computing and electronics - are seen as the most difficult for work experience; some ITeCs find difficulty in work placement because of their surroundings; there may be too many institutions in some regions seeking liaison with industry.

The proportion of placements involving trainees in work directly related to IT ranged from 10% to 100% with an average of 91.2%.

Examples of the type of work experienced were as follows:

1. Modern Office: Accounting; Data Preparation; Electronic Mail; General Office Duties; Hotel Reception; Invoicing; Payroll; Stock Control; Surveys; Tourism; Use of Business Packages; Video text editing; Word Processing.

2. Computing: Computer Graphics; Installation; Operator; Programmer; Sales; System management looking after a small network.

3. Electronics: Assembly; Cabling; Instrumentation; Maintenance; Microinstallation; PCB manufacture; Repairing T.V., Hi-fi, computers; Technician; Telephone exchange; Testing.

ASSESSMENT AND CERTIFICATION

There is a very wide variety of certificated syllabuses which are followed. Table 22 indicates their relative popularity.

Eight per cent of the ITeCs in the survey reported no form of certification or recognised course.

Apart from recognised courses most ITeCs use various forms of in house assessment. In order of popularity these are: Regular Reviews: 52%; Tests: 37%; Interview: 22%; Project Work: 15%; On the Job Assessment: 15%; Self Assessment: 7%.

DESTINATION OF TRAINEES

The following systems of recording the destination of trainees were reported: Leaving form/file: 37%; Database on computer: 33%; Word of mouth: 4%; Careers service: 4%; No record kept: 22%.

The proportion of trainees going on to different destinations according to the survey are shown in Table 23 and figure 7.

PRESENT AIMS AND FUTURE PLANS

This was an open forum for comments. Responses to the question "How would you describe the main aims and purposes of your centre?" were categorised as shown in Table 24.

This concludes the summary of information collected in the ITeC postal survey. It has been reported above largely without comment and discussion. The next part of the chapter follows up the issues raised here by considering the information collected during interviews and visits.

PART B: THE ITEC INTERVIEWS: RESULTS

The interviews carried out whilst visiting 24 ITeCs followed similar guidelines and addressed the same issues as the postal survey. However, less attention was paid to collecting numerical data and more emphasis placed on allowing interviewees to express opinions and talk more openly, for example on the purposes of their ITeC and its success in achieving them.

The comments and opinions expressed by ITeC staff have been grouped under the headings shown in TABLE 25. This structure follows the same outline as the questionnaire results discussed above and relates to the issues described in the introduction to chapter 6.

THE ITEC ITSELF

Staff

Staff in ITeCs seem to have a wide range of experience and backgrounds. Some are ex-forces, some ex-teaching, a few staff were ex-police. Industrial experience was generally felt to be a more important quality in supervisors than prior teaching experience:

> "We feel that having supervisors from industry is important because one of the differences between us and colleges is that we want to approach industry and say 'What are your requirements' and we will do our best to accommodate them".

Industrial experience was certainly valued more highly than formal qualifications. Staff in ITeCs visited were largely non-graduate and indeed at least one interviewee expressed misgivings over employing graduates:

> "Quite a few applicants have a degree in computer science and claim to have the expertise but believe me they know as much as my youngsters after 3 months."

A degree of animosity was shown in some interviews towards the school system and its teachers:

> "The worst supervisors that we take on are those who have had teaching experience - they are already moulded by the education system."

(This point will be followed up later.)

Staff in ITeCs generally seemed to be satisfied with the in-service training (INSET) available to them. Indeed the development and growth of the STAFF seemed to be one of the most valuable side-effects of an ITeC. Staff seemed to benefit from their experience in ITeCs and become a valued commodity in the market place. Despite this apparent upward mobility of staff only one ITeC (a London centre) reported a staffing problem - it was felt here that the starting salary was too low to attract supervisors of the "required standard". This was the ITeC which turned down some applicants with a Computer Science degree.

Resources

ITeCs visited were well resourced, as the postal survey indicates. Most aimed at a target of one keyboard per trainee. Some misgivings were expressed on the value of the BBC micro, although this was by far the most common machine:

> "For a start we should forget those Beeb's ... there's not one decent commercial program that runs on a BBC so you can't teach youngsters what a computer can actually do".

It was felt by some staff that schools were "wasting their time" by teaching pupils to use the BBC micro., especially in BASIC programming. Others expressed contempt for the BBC micro but realised that trainees were familiar with them:

> "We have 20 of the wretched things. They're all right for starting on ... but if you say that we are here to train them for the work environment, I mean, who uses BBCs in an office?... but they (the trainees) love 'em, because they know 'em."

This issue perhaps indicates more than any other the fundamental difference between the school and ITeC approaches to education and training.

Almost every interviewee was satisfied with their level of resourcing in staffing, hardware and software:

> "We have all the software we need, and what we haven't got, we buy."

Staff-student ratios were almost all in the region of 6:1, which was felt to be satisfactory by the staff.

INTAKE AND SELECTION POLICIES

Selection to ITeCs mainly takes place by interview. Enthusiasm and willingness were often singled out as the main criteria. Many ITeC's expressed a positive desire to take trainees from the whole ability range, with some discriminating positively in favour of certain groups:

> "We should be aiming to train a broad band of abilities and not just those who are at the top end of the ability range."

> "Applicants with academic qualifications are discriminated against. There is discrimination in favour of applicants from areas of inner city deprivation."

> "Commercially if you start being selective in ITeCs you are going to have very few trainees by December because they have gone out to F.E., work etc.. We started from the base line of disadvantaged kids, so we do not do any kind of selection apart from availability of space on courses."

Several ITeC staff felt that a certain amount of hidden selection and prior filtering went on before trainees arrived on the doorstep. This appears to take place in careers guidance and local careers services:

> "We have a good relationship with the local careers service, and I suspect that a certain amount of filtering went on before they came here."

This suggestion, and in some cases suspicion, of prior filtering is shown to be justified by figures made available by the MSC on intake into ITeCs. The figures, shown in Table 26, indicate that trainees in ITeC's are far better qualified on entry to YTS than their Mode A counterparts, except in London. The difference is most marked in the Northern ITeCs. In reality, therefore, trainees entering ITeCs are generally better qualified (compared with their peers) than perhaps staff realise:

> "We are operating right down the intellectual tree and I suspect we need to be working at a slightly higher level ... we may well attract that sort of youngster." (a Northern ITeC)

> "We get nothing in the way of material from the schools and we get a pretty awful trainee. It takes us 2 months at least to knockout the education system and put in the training system."

Some ITeCs are already using aptitude tests (mainly focussed on literacy and numeracy) - others realise that more selection will need to be introduced in order to achieve certain aims, such as self-sufficiency, in the future:

> "To achieve MSC's directive to ITeCs to reach Approved Training Organisation status by this ITeC is considering the introduction of nationally recognised courses. This will mean that the intake criteria may need to change."

The gender issue was seen to be of major importance in discussing selection procedures. ITeCs in rural areas (such as Northumberland, Dartington and Somerset) found it virtually impossible to recruit girls (with two girls, one and one respectively). Others, including two in urban areas, had a male:female ratio of around 3:1. Even where positive discrimination occurred, girl entrants were in the minority:

> "There is a policy to encourage the type of people who are disadvantaged in gaining employment: women, disabled people, ethnic minorities. Selected intake reflects the local population locally as regards race but not sex: not enough young women."

Reasons suggested for failing to attract girls varied. One Northern ITeC suggested that the careers office "does not channel girls to the ITeC". Others blamed traditional values and stereotyping in the surrounding catchment area:

> "Traditional values in the local community govern gender roles."

Similar problems exist in achieving a representation of different ethnic groups. One ITeC supervisor described the prospective entrants as "almost 100% white and male". Many felt that their intake, although largely white male, was a reflection of the local population and catchment area. In other ITeCs the intake was deliberately balanced according to gender and ethnic background. One ITeC manager felt that MSC regulations discriminate against "young Asians" who wished to enter from a school 6th form:

> "... many young Asians went back to school rather than go on the dole, often firmly guided there by their parents; other youngsters tended not to do this. Roughly equal numbers of Asians and non-Asians joined the ITeC after September to replace those leaving for employment, but the MSC regulations do not permit anyone who has stayed on at school, for however short a time, to be considered for a continuation place. This regulation has had the effect of discriminating against committed young Asians, virtually all

of whom came to the ITeC from school 6th forms, not the dole queue, if they were late entry to the ITeC. MSC have been made aware of this problem in very clear terms from this ITeC, but the ruling still remains, so does the de facto discrimination."

CURRICULUM OFFERED

Gender

Gender differences were seen as equally problematic in the curriculum of the ITeCs, and in their work placements. Computing and electronics were seen as the boys' domain, with modern office for the girls:

> "In the last 2 years only one girl has trained in computing and electronics. Boys do not tend to opt for electronic office."

> "... in a similar way to the intake of trainees, the applicants to administration (modern office) are about 85% female, but when you look at the electronics and computing, there is a complete reversal."

Gender bias in curriculum choice is strong, and ITeC staff are clearly aware of it. However, the problem is diminished in the eyes of some staff in view of the subsequent gender bias in employment prospects. By opting for "modern office" girls were seen as having better job prospects in many cases than their male colleagues in electronics and computing:

> "In the past three years no girls have opted for electronics as a speciality in spite of the encouragement we give them. Two boys have specialised in Electronic Office during the same period - not because they particularly wanted to specialise in that area, but because they regarded it as the easiest option and were clearly not going to make any progress in computing and electronics. I would find this very disheartening if it were not for the fact that there are very few jobs in electronics and computing in this area. What use training girls in electronics if no employer will give them a job when they're trained? At least there are fair job prospects in office work."

It seemed that the girls' prospects were enhanced by going along with, even taking advantage of, the gender stereotyping present in employment:

> "The girls see computing, and especially its electronic office element, as a realistic choice in terms of job prospects."

Content

The actual content of the curriculum has already been introduced in reporting the postal survey. Several points were made by interviewees in relation to it. Some felt that the programming component was perhaps no longer relevant to employment:

> "The YTS scheme cannot and should not aim to produce professional programmers."

> "In my opinion there's no room at the top for a novice in computer programming."

This issue relates closely to the employers' survey discussed in Chapters 8 and 9.

A similar misgiving was expressed by one interviewee on the value of the electronics work in the curriculum:

> "The level of electronics required for repair work is quite high and we don't feel that our trainees are of that calibre."

> "The numbers involved in electronics are fairly small, whereas in the office area we just can't train enough."

In contrast, the latter ITeC (and others) stressed the value of the office component of the curriculum.

> "...the office area is so much more productive: that's where most of the IT is, you can transfer from office-type skills to viewdata or Telecom gold; that's where the real expansion's going to come."

Some staff felt that little guidance had been given to them on the curriculum at the outset. This seemed to have dictated their approach to curriculum planning:

> "The trouble is that when we set up we were essentially given very little guidance on what curriculum we should have, what we should teach, what equipment we should buy; we found this both exciting and a challenge, but bloody hard work. We bought what we thought the market place out there was buying, we taught what we knew, and we based everything on that."

This point was emphasised by others, whose strategy was to see what was "going on out there" and then buy and plan accordingly, leading very much to a "training" approach rather than an "educational" emphasis:

> "We want to use up to date equipment to train people in advance of people in trade and industry actually needing them. We hope to train people on the sort of equipment that local industry will be buying."

Two staff expressed their own doubts about a narrow, vocational approach to IT training:

> "Vocational training in isolation is a fairly empty process ... monkey training."

> "There is a disparity between the educational view towards computing and what the MSC says it wants in that area. It is not enough simply to train people to use a package; you will get a more effective operator - even at the low level they are dealing with - if that operator has some background knowledge of what it's all about."

Work Experience

Work placements were seen by many staff to be a problem, particularly within the one-year scheme. The short placements possible were seen as too restricting, often leading to reluctance amongst employers to offer them:

> "We found that the employers were exceedingly reluctant, quite understandably, to take youngsters on for the 4 weeks. By the time they'd settled down ... and were picking up the skills appropriate to that organisation ... it was time for them to leave."

> "The trainees were seen by many employers as a "liability". The 2 year YTS is welcomed because the longer placements are likely to be viewed more positively by the employers."

Many staff felt that the two-year scheme would improve work placements tremendously, and further that the success of the two-year programme would hinge on the quality of work placements:

> "If we get good placements, the two-year scheme will go a bomb, otherwise it will be no good".

Almost all the staff interviewed had concerns of some kind over work placements. One (and one only) felt that employers must be "genuine":

> "There is a shortage of good genuine placements where you can walk away and say they (the employers) are not fiddling the system."

A number felt that their links and liaison with industry could be better, although there was a need for staff time to develop these links and work placements:

> "These (work placements) used to be difficult to find but now the situation has improved since one member of staff (in the centre as a whole) is working virtually full-time on placements."

Two other problems with work placements emerged in discussion. Firstly the problem, already prominent in curriculum and intake policies, of gender. For example,

> "The boys who specialise in electronic office find it hard to obtain work placements."

Secondly, comments were made that a number of trainees did not like work placements:

> "Trainees don't like work placement: It's boring - when can I come back?"

Every person interviewed felt that work placements in ITeCs would improve within a two-year scheme.

Certification

The YTS certificate was commonly perceived as having little value, either by trainees or by employers. One ITeC had developed its own "Company Certificate" as an alternative:

> "The first ITeC I was at we did that and the trainees would ... get their certificates at the presentation at the end, roll up their YTS certificate and throw it in the bin and go away with this one all pleased as punch, you know because it looked nice, it looked impressive."

One common alternative, as the postal survey indicated earlier, is the City and Guilds 726, although one reservation was expressed:

> "Employers tend not to know what the City and Guilds 726 is but the manager believes that this certificate is better than no certificate at all."

DESTINATIONS OF TRAINEES

The staff interviewed had an obvious sense of optimism that many of their trainees were going on to jobs related to the IT training received. For example, in one urban ITeC in Yorkshire:

> "We've got a really high proportion of employers who ultimately employ ex-ITeC trainees."

However, on closer analysis it transpired that few ITeCs monitor closely and systematically the immediate destinations or the longer term future of their trainees:

"After they've left you, you don't always get any feedback."

This absence of monitoring by ITeCs of their own trainees destinations seems to be a surprising omission, particularly in those ITeCs who see their main function as satisfying the IT needs of employers. It would seem to be a vital element in the self-evaluation of any institute dedicated to vocational training. Many are aware that the MSC carry out their own survey of the longer term destinations of ITeC trainees. The results of the 1985 survey of YTS leavers carried out by MSC is shown by region in TABLE 27.

The MSC data indicate that, on average, only 53% of ITeC leavers in 1985 were still in employment after three months with some regions and areas well below this figure. This national average compares with a figure of 64% for Mode A leavers (it could be argued, incidentally, that this is an unfair comparison). The discrepancy between the staff optimism and "official" MSC data surely needs investigating.

One specific example of the destinations of trainees from a small, rural ITeC was detailed during interview as follows: fourteen trainees left the centre in 1985 - two boys joined the RAF in "electronics and radio"; one girl joined a large store to carry out "data input but had since been made redundant"; one girl became an optician's receptionist; one boy went into "electrical installation", another boy obtained a job using a micro in a local builder's office; one boy joined an IT company on printed circuit board construction; one boy went into Further Education; six destinations were unknown.

This kind of intimate knowledge of trainees' futures was rare and had only been obtained by personal contacts and networks in a small town. In a larger, more urban ITeC the supervisor interviewed was unsure of such details:

Q: "Do your trainees go into IT-related jobs?"

A: "They're all IT-related but the relation is often quite slim ... Most of them tend to be in offices where there is a microcomputer and it will involve some use of that microcomputer which is often an important factor in them getting the job."

Q: "So without your training they wouldn't have got those particular jobs?"

A: "Oh, I think that's definitely true."

The above quotation is typical of the common feeling of confidence that ITeCs were enhancing the job prospects of their trainees. It seems surprising therefore that ITeC staff nationally are not carefully monitoring their trainees' destinations - firstly to support such confidence and secondly to assist in their own evaluation. Such monitoring would also help in evaluating the curriculum. Again, there is a general feeling that the greatest success is in the office area:

> "Best success is the office work. Computers: fairly successful, most go in as operators or retailing/demonstrating."

However, data to support this feeling is not being collected either by the MSC or by individual ITeCs.

In summary then, it seems that insufficient facts are available to evaluate either the general success of ITeCs, or their success in specific areas of the curriculum. However, the success or otherwise of ITeCs can only be judged within the general context of the purposes of an ITeC.

THE PURPOSES OF AN ITEC

There was a considerable range of opinion on the function and purposes of an ITeC. Different views were expressed on approaches to income generation and on specific ways of achieving it. Opinions on the basic aims of an ITeC varied along a spectrum with direct vocational training at one end, and the personal development or "psychological welfare" of trainees at the other. The views expressed are considered below.

Income Generation

Several interviewees were doubtful about their ability to become self-sufficient:

> "It's not realistic - completely unrealistic - certainly as far as this ITeC is concerned ... any income we generate we have to generate in our own time, virtually. You've got to make up your mind whether you're a production unit or a training unit. You can do both but only if you've got enough staff."

The possible conflict between income generation and adequate training was seen as a key issue:

> "We are against income generation that exploits the trainees. However, it is possible to devise income generation schemes that support the training and give the trainees work experience in the ITeC with responsibility to an outside firm. The assembly and testing of electronic components is one such example."

One urban ITeC in the north specified two types of income generation which they would NOT undertake: mass production and work that threatened existing employment. The two criteria were expressed as follows:

> "If the quantities involved at any one time are too great, in other words if it becomes tedious mass production ... and if I thought that the work which was being done could be done validly by an outside firm, in other words which would threaten existing employment."

One London ITeC felt that its revenue generation had not compromised its training function:

> "This ITeC can engage in revenue generation in the form of developmental work (by staff) and assembly work (by trainees) for Sperry Computers. It would not consider compromising its function as a training establishment. It is also considering the introduction of courses for firms run by its staff as long as they receive extra pay for such extra duties."

In other ITeCs a wide variety of small schemes for generating income were used. To give a specific example, an ITeC in the North-East used the following schemes: helping a small firm with the development of a CEEFAX receiver for the BBC micro; the assembly of power supplies; the assembly of circuit boards; the writing of software, e.g. for a safety in the home campaign for local schools; the preparation of CVs, reports; photocopying; the service and repair of home computers, TVs, electric vehicles for the disabled, washing machines; the building and maintenance of database and the running of a mail merge for a local theatre company.

However, such a wide range of small, enterprising schemes was unusual.

Development of Trainees

All staff interviewed showed a high degree of sensitivity towards the outcomes and development of their trainees:

> "Many of the trainees have a background of social problems ... relationships are formed between supervisor and trainee that are often closer than anything experienced by the trainee at home."

All stressed the importance of personal development and attitude improvement both as a good in itself and for improving job prospects. Two examples serve to illustrate this point:

> "Trainees have often left school with a negative attitude towards finding a job. One aspect of the training is to turn this into a positive attitude."

> "...they might have got a job though it might not always be totally relevant to what they've done here - but, you get back to the personal development: would they have got that job if they hadn't come here?"

One important general was raised by several staff. They felt that an IT training, even if vocational, was perfectly compatible with general educational aims and personal development:

> "Broadly, what are we here for?... On the one hand you're providing youngsters with information technology related skills and on the other hand you are providing an environment in which they are maturing, hopefully, from an immature school-leaver into an almost mature young adult. The two are complementary."

An ITeC was seen by one manager as a medium for providing both general education and enhancing vocational skills:

> "There is a tendency when you're a trainer to train that which you know about whether it be electronics or computer programming. Whereas ... what I think we're in the business of doing is actually providing a general education using IT as the medium ... and incidentally you pick up skills which will be useful in getting a job."

Evaluation

Paradoxically, despite this impression of a caring and supportive environment, some staff felt that ITeCs were perhaps not a cost-effective means of achieving personal development and attitude improvement:

> "...when I sit back and I think about what it costs to run this centre ... and when I look at what our kids achieve at the end of it ... well ...At a personal level they achieve a lot ...but you think it cost about £8,000 to get that kid through. Is there not a less expensive scheme to achieve the same things?"

This feeling was aggravated by the fact that not all trainees went into IT-related jobs:

> "When you look at how much the individuals have gained from their year here ... you might say, well, it's a very expensive way of improving the bottom end. Not all go into IT-related jobs."

Q: "Are you disappointed by that?"

A: "No, I'm not. It depends on your philosophy."

The main point emerging from this section of the enquiry is that an ITeC can only be evaluated within the framework of its overall aims and purposes. Is the purpose of an ITeC to provide vocational training in IT? If so, they should perhaps be evaluated in terms of trainees' entry into IT employment. But if the aims of an ITeC are broader, encompassing personal development and attitude improvement, then evaluation becomes more complex.

LINKS AND ATTITUDES

Industry Links

A number of staff felt that their liaison and communication with people in industry could be improved:

"It's fairly difficult to get hold of these people. We are hoping to try and forge greater links. We want to know what training they require in order that our young people will be suited to the jobs available."

Some staff were critical of industry and, in particular, its attitude to training:

"the market place is not all that well educated itself"; "people are only scratching the surface of the potential of computers and that situation has got to change by our doing more adult training"; "the microcomputer industry is its own worst enemy, being boffin-based and producing very user-unfriendly packages. This scares users off." (Wordstar and D.Base cited as typical packages where the user needs to know a great deal to realise their full potential); "the state of training in industry generally is appalling. If industry is not prepared to invest in training I don't think that there is a great deal that ITeCs alone can do."

School Links

Criticism of industry, however, was gentle in comparison with the animosity held by some interviewees for the school system:

"We have to start out by repairing the damage that school teachers have done".

"Generally speaking schools don't point kids in the right direction."

"Schools are directing the wrong material into technology."

"Computer literacy and computer studies give totally the wrong bias. They (schools) spend their time teaching them how to program a computer ... a total and utter absolute waste of time for the 16 year old who is going to leave with CSE Computer Studies ... about as much use as an ashtray on a motorbike."

Such animosity was not common however. Other staff were aware of the problems that teachers found. For example:

> "The system won't allow school teachers to be aware of what goes on outside their own closed surroundings. I'm not blaming the teachers personally - it's the system. If industry doesn't know what it wants how on earth can you expect school teachers to really know what they need to produce in order to provide for industry."

Most staff were aware of the need for better links with industry and schools, although time was seen as a problem:

Q: "Do you have close links with schools?"

A: "With the careers service, yes. Our careers service is very good. They make strenuous efforts to find out what we want in terms of trainees. We don't really have close links with SCHOOLS. Its really a matter of time."

One ITeC in an area whose education authority was involved in the Technical and Vocational Education Initiative suggested a possible overlap with the ITeC:

> "We will probably get a lot of the people who are half-way through the TVEI course at 16 leaving it and coming onto the ITeC."

At present then, it appears that few positive links between schools and ITeCs have been forged. There is clearly great potential here for better liaison, particularly as TVEI becomes fully established. In an area of education and training involving such a large outlay on equipment and resources it seems that greater liaison between schools and ITeCs would be cost effective and beneficial to both parties.

CONCLUDING REMARKS

Chapter 6 has presented a selection of evidence from two parallel inquiries using different methods into the provision of IT training by the ITeCs. Clearly these centres are an important source of training for employment in certain occupations involving IT. (Employers' perceptions of what those occupations might be are considered later). The evidence on education and training in ITeCs, staffing provision, attitudes to industry and vocationalism and resources for learning show an interesting contrast with school education in IT. Curricula, approaches and attitudes indicate a totally different strategy in preparing young people for employment. Those strategies will be evaluated in the light of the major survey of employers' requirements for IT personnel which follows in Part Three.

PART C: IT IN SCHOOLS AND YOUTH TRAINING: A SUMMARY OF THE EVIDENCE

A vast amount of data was collected in the surveys of school education and youth training provision in information technology. In a sense, the data stands on its own and is open to the reader's own evaluation and interpretation. However it may be useful at this stage, before going on to consider the inquiries into IT in employment, to recapitulate briefly before moving to Part Three. The points below are therefore offered as a summary of the findings of Chapters 5 and 6, with some evaluative comments added. A full evaluation of these findings in relation to the perceived needs of employers is reserved for the concluding chapters.

1. IT IN SCHOOL EDUCATION

(a) School Courses

Examination courses in computing have dominated IT education in schools. The subject "computer studies" has grown steadily in terms of examination entries. However, two clear trends emerge from the interviews and electronic survey. Firstly, there are an increasing number of courses labelled "information technology" either being discussed by schools or recently introduced, many of which are examinable. Lower down the school, information technology courses are available in an increasing number of schools to all pupils, sometimes taking over from the less broad computer appreciation or computer awareness courses.

Secondly, the majority of schools see the introduction of computer assisted learning (CAL) across the whole school curriculum as the next stage in their development. Some already have CAL in a number of subjects (science and maths. most commonly). Many others expressed the intention of introducing CAL across the school curriculum. The restraints on such curriculum development, however, were present in every school.

(b) Restraints on IT in the Curriculum

The most obvious constraint on the diffusion of CAL is the lack of computer hardware. In non-TVEI schools the average computer:pupil ratio (labelled the computer access factor) was 26:1. This low access factor is only a part of the problem - in a clear majority of schools (67% in the electronic survey) most computers are located in computing labs. or computer studies rooms. Findings also indicate that the existence of networking is correlated with the poor uptake of CAL across the curriculum.

Two further restraints emerging from the surveys are the lack of technical or non-teaching support for IT staff, and the need for in-service education across the school staff. In almost every school surveyed and interviewed, teaching staff (many of whom were expending great time and energy in trying to spread IT across the curriculum) received no paid technical support. Many teachers used older pupils such as fifth and sixth formers, as unpaid assistants e.g. in copying discs, setting up hardware, troubleshooting etc. This problem was compounded by the lack of in-service training amongst other staff. The school IT person is often, therefore, both a technical assistant and an in-service trainer to other teachers.

A final impediment to the diffusion of IT may well be the background of the staff involved. The clear majority of teachers involved in IT had a background in mathematics. This may well result in the view, held by teachers and pupils, that the use of computers has something to do with mathematics. The persisting perception is that computers are number crunchers rather than information handlers. Additionally, the number of male teachers involved in IT was four times greater than the number of females. This may send similarly unwanted messages to other teachers, pupils and parents.

(c) TVEI and School IT Education

The interview summaries provide many clues to the effect of TVEI in schools and they will not be repeated here. The three main effects of TVEI on school education in the IT area appear to be as follows:

- a considerable increase in the IT equipment and the general resources available to the schools involved,
- a large improvement in pupil motivation,
- a tendency towards information technology courses at 14+ levels, rather than computer studies.

As with non-TVEI schools, the TVEI schools visited intended to spread the use of IT across the curriculum but faced similar barriers.

Many teachers in TVEI schools questioned the VOCATIONAL significance of their IT courses, feeling (for example) that they could not train people for industry partly because of the sheer pace of change. Others felt that their own knowledge of IT in industry and commerce was either poor or non-existent and therefore vocational relevance was a difficult teaching aim to achieve. Finally, the vocational significance of the IT component in TVEI, and perceptions of it, will vary widely from one region to another. In areas having few IT providers or IT users in local industry the vocational relevance of IT education, either real or perceived, appears to be small.

2. TRAINING IN THE ITeCS

The Information Technology Centres are clearly an important source of IT training. This section draws together the main findings from the ITeC survey, and relates them to other areas of education.

(a) Resources in the ITeCs

Resourcing, in terms of staffing and equipment, is well above the level of that in school IT education. This is partly a reflection of the ITeC approach to training, but also perhaps a result of their source of funding and sponsorship. Thus the staff:student ratio is in the region of 1:6, as against TVEI schools with a ratio of around 1:15. The difference between school and ITeC resourcing is more marked in the provision of hardware, with ITeCs having a "computer access factor" of around 1:1 compared with 1:47 in non-TVEI schools and 1:26 in TVEI schools.

School teaching staff are very different in both approach and background to staff in ITeCs. The latter, according to the survey, are more likely to have industrial experience but less likely to be graduates. Staff morale appeared to be far higher in ITeCs than in schools though this is an intuitive observation which has not been quantified. If this is the case, it may well be due to the higher level of resourcing and the more favourable staff:student ratio in the ITeCs.

(b) Intake and Selection Policies

Many ITeCs do not select candidates, except by interview, where qualities such as enthusiasm and willingness are sought. However, it seems that a certain amount of hidden selection, such as filtering by careers services, is occurring so that entrants are not as low down the ability range as some staff assume. This suspicion of prior selection is supported by MSC figures on entrants to ITeCs and their qualifications.

In the majority of ITeCs the number of male youth trainees far exceeds the number of female trainees, in the worst case with a ratio of 29:1.

Two staff openly questioned the wisdom of providing a capital and labour intensive scheme of IT training for students whom they described as "at the bottom end of the intellectual tree". One supervisor, for example, suggested that ITeCs were doing "the right job for the wrong people". Whether or not ITeCs are ECONOMICALLY worthwhile can only be judged in terms of a full-scale evaluation of the gaps which they fill in IT skills shortage in employment. A thorough assessment of this function of an ITeC is needed. It must be emphasised, however, that few ITeC staff saw the provision of ready-made IT employees as the sole purpose of an ITeC.

(c) The ITeC Curriculum

There is strong evidence that traditional gender bias operates in the curriculum of the ITeCs, both in taught courses and work placements. There is a clear female bias towards modern office courses and work experience, with boys tending towards electronics and computing. This finding will hardly come as a surprise. It would seem unfair to attribute blame to ITeC staff in this matter, though perhaps a restructuring of the curriculum could eliminate some of the gender drift.

There is evidence to suggest that the modern office aspect of ITeC training is the most vocationally relevant, though again this needs more thorough evaluation. Some aspects of the Computing component, in particular the teaching of programming, are being seen as increasingly less valuable.

(d) Destinations of Trainees

The precise destinations of trainees, and the relevance of their ITeC training to those destinations, is a link on which only very patchy information exists. This seems surprising in view of the emphasis in most ITeCs on training for jobs rather than education, and the expressed beliefs in the past by politicians, such as Kenneth Baker and Norman Tebbit, that ITeCs will help to ease skill shortages. The conviction that training will create jobs needs careful evaluation, not least in ITeC training.

Destinations of trainees were largely in the modern office area, with electronics and computing coming a poor second and third. However, no reliable quantitative data could be collected within the constraints of the inquiry. There is also a noticeable discrepancy between MSC data and the data provided by ITeC staff - the latter providing the more optimistic picture of trainee employment.

(e) The Purposes of an ITeC

It seems an irony that, despite the huge difference in funding and staffing between schools and ITeCs, the aims of IT education (or training) are so often seen in the same way by staff in both areas. Personal development, general skills, confidence and psychological welfare were valued as highly by ITeC supervisors as by school teachers. Information technology training and education were seen as vehicles for achieving those aims.

However, the VOCATIONAL aspect of IT education and training is a stronger element in the ITeCs than in schools. As suggested earlier, any evaluation of the ITeC programme must surely take this into account. Their trainees' success in gaining IT-related employment is a major factor in their assessment, which should not be as prominent in evaluating school IT education.

There is surely a need for a thorough but fair evaluation of the ITeCs within a broader discussion of their overall aims and objectives, and their relationship both to employment and to other areas of education.

(f) Links Between ITeCs and Other Areas of Education

Communication between ITeCs and other areas of education, according to evidence from the survey, is weak. However, communication is a two-way process and ITeCs alone cannot be blamed.

It is apparent that SOME ITeC staff are critical of the school system, its products, its teachers, its approaches and its resources. Their views are based, though, in most cases on small and unrepresentative samples. From the other angle, it seems that schools are largely ignorant of the work of ITeCs, and liaison between a school and its nearest ITeC was noticeably absent in the survey. Communication between teachers involved in school IT education and ITeC staff would surely benefit both parties e.g. in sharing resources, attracting more girls into IT training, comparing teaching approaches, and so on.

More concretely, many schools could provide ideal work experience for ITeC trainees. The desperate need for non-teaching support and technical help in developing IT in schools (see 10.1.2) could be met by youth trainees with skills in electronics, computing and modern office applications. Many of the jobs currently being done by unpaid school pupils could be done more professionally by ITeC trainees. Jobs could include: creating databases, help in word processing instruction, copying discs, starting and managing software libraries, running networks, setting up equipment, general troubleshooting, diagnosis and repair. At present many such jobs are carried out by qualified teachers.

In the longer term, given financial support, schools could provide rewarding and interesting PERMANENT JOBS for ITeC leavers as non-teaching assistants. With around four and a half thousand secondary schools alone in England and Wales, the potential for work placements and future employment of ITeC trainees is enormous. Such links would prove to be economically worthwhile as well as educationally valuable.

One final area where liaison could be improved is that between ITeCs, and further and higher education. Few people in higher education have any knowledge of the ITeC programme - this is one area, in a time of acute personnel shortage, where links involving non-conventional entry into higher education courses could be established. This could be valuable both to trainees who may have gained little from school education but have untapped potential, and to employers with severe skill shortages but at higher levels.

PART THREE: THE PERCEIVED NEEDS AND REQUIREMENTS OF EMPLOYERS: EMPIRICAL ENQUIRY

CHAPTER 7

THE STUDY OF EMPLOYERS' NEEDS IN IT: APPROACH, STRATEGY AND METHODS

Part Two of this inquiry involved an analysis of recent and current provision of IT education and training from different perspectives.

Part Three goes on to examine the requirements of employers in IT, before attempting to evaluate IT education and suggest guidelines for its future.

This chapter describes briefly the general strategy and approach adopted in setting out to determine employers' needs in the field of information technology. The importance of a "reflective" approach is outlined, as well as the use of a triangulation of methods and its justification. Finally, the pattern of inquiry actually used and leading to the findings described in subsequent chapters is described.

LINEAR V NON-LINEAR

A model, perhaps a caricature, of a "typical research project" is shown in figure 8. At the outset the path which the research will take is planned and designed, decisions are then made on sampling, data is collected, then analysed and finally the data and the report itself are written up. This linear approach to the research process is, as Burgess (1985) points out, an ideal model and may never be employed in reality. Irrespective of whether the model is an ideal or a real one, a decision was made at the outset to adopt a non-linear approach to the inquiry. In other words, as figure 9 attempts to depict, the activity of research design was a continuous one. Aims and methods were continually analysed in the light of discussions, the data collected, interim findings and of course the problem of reporting. In other words, the design of the research was a continuous and "reflexive" activity, (Hammersley and Atkinson, 1983) which involved looking backwards (to what had been done) as well as forwards.

As discussed in the introductory chapter, linearity in research design is often suggested or implied by the way in which inquiries and projects are written up. This point is discussed at length by Schatzman and Strauss (1973) who distinguished between the process of research itself and the act of communicating it:

> "....research itself involves a different organization of activity than research writing, and has a different social locus. Its locus is "in the field", in the special relation of the researcher to his object of inquiry, whatever his method. Research has mainly to do with the process of inquiry; research writing has to do with the process of communication". (Schatzman & Strauss, p.143)

The complexities and sheer "messiness" of the progress of an inquiry are therefore often hidden from the reader by the act of over-simplification (and implied linearity) in the eventual write-up. The account which follows in subsequent chapters is no exception.

THE QUALITATIVE/QUANTITATIVE MIX

A decision was made early on to adopt a variety of methods, some of which are often labelled 'qualitative', others 'quantitative', although the distinction rarely held in practice. Work had to be done initially in identifying the key issues which should be examined in studying the use of information technology in employment and its implications for education and training. To this end, a series of initial interviews were conducted with a range of employers to explore broadly their use of IT, their recruitment policies, and selection criteria. As a result, a semi-structured interview schedule (Appendix 4) was developed to identify key issues in employment. This schedule later formed a basis for the employers' questionnaire. The interviews provided many data which could be termed 'qualitative' e.g. employers' opinions, selection criteria, general policies towards IT and so on. But they also provided many easily quantified facts e.g. numbers of recruits at different levels, trends in numbers of employees and so on. Data of a similarly mixed nature was also obtained from the questionnaire which followed. Employers were asked to quantify certain policies, e.g. use of IT, numbers of graduate recruits, but they were also invited to express their opinions, needs and predictions during more open questioning.

In short then, there was no simple divide between qualitative data collected by one method, and quantitative data by another. This mixture will be reflected in the way that the results themselves are analysed and reported.

As already discussed, a similar mixture was used in studying the current state of IT in education and training. There can be no substitute for personal contact, lively and interactive interviews, and first hand observation. These methods were used as far as possible within the constraints of time and money. But in addition, in order to reach a larger sample, postal surveys were carried out using both electronic and traditional methods.

AN "ETHNOGRAPHIC" APPROACH

In making personal approaches to employers it was decided at the outset to adopt an "ethnographic" approach to interviews, discussions, and observations, (as in the visits to centres of education and training described above).

Ethnography is often described as an aspect of anthropology. ("Ethnography: the scientific description of nations or races of men, their customs, habits and differences": SHORTER OXFORD ENGLISH DICTIONARY). No claim is made that the inquiry below is a true ethnography in the sense often used (see, as an example, Holdaway, 1985). However, many of the following features of ethnography as a research strategy were considered and adopted in guiding the approach to visiting and observation:

1. Guiding Principles

Ethnography streses the importance of:

(a) understanding the perspectives of the people under study.

(b) observing their activities in everyday life.

2. Gathering Data

> "The ethnographer conducts 'participant observation' by watching what happens, listening to what is said, asking questions, ...in fact, collecting whatever data are available to throw light on the issues with which he or she is concerned." (Hammersley & Atkinson, 1983).

3. Problems During Research

(a) Access e.g. to the necessary data, the important people, the right contexts.

(b) Relationships with people, groups, or organisations being studied e.g. their impressions of the ethnographer: personal appearance, dress, technical knowledge, natural conversation, etc.

(c) The role of the participant observer may vary from complete participation to complete observation. The aim of an ethnographer is to "maintain a more or less marginal position". (Hammersley and Atkinson, 1983). As Stenhouse (1982) has pointed out, "the conditions of condensed fieldwork preclude classic participant observation".

4. Interviewing:

(a) Ethnographers do not decide totally beforehand the questions they want to ask, though they may enter the interview with a list of issues to be covered.

(b) Interviews are seen as one aspect of observation.

(c) Group interviews are quite common in ethnography.

(d) Interview data must be interpreted against the background and context in which they were produced (see subsequent case-studies particularly).

5. Using Documents

In ethnography, it is possible to draw on all sorts of 'inside' written accounts, documents etc. These written accounts are an important feature of the culture being studied, and in particular form an essential part of case-study.

6. Recording and Organizing Data

Methods may involve the use of field-notes, audio-taping, video-taping, film, collection of available documents. A database may be useful for organising data.

7. Analysing Data

This must be a continuous process, influencing every stage of the inquiry. Analysis of data feeds into the process of research design, itself a continuous and reflexive process.

In a sense, as noted in Chapter 1, "two cultures" were being studied: education and employment. In Industry Year (1986) much attention was paid to the cultural divide between industry and education. Indeed the Director of Industry Year, Sir Geoffrey Chandler, often spoke of Britain's anti-industrial culture within an industrial society. One of the aims was to compare the "two cultures" and to consider where the divide might indeed hamper Britain's industrial performance.

In addition to indulging in cultural anthropology (if that is not too pretentious a term), one was often engaged in physical anthropology. It seemed vitally important to compare the equipment and resources employed in education and training for new technology with that encountered in employment. How would computing resources compare within education and training, and without to physical resources (hardware & software) encountered in industry? Can education have any hope of matching employment and therefore of preparing its products for it? The comparison of physical resources across areas of education and training and then across the "great divide" to industry formed an interesting ramification of the study.

THE RESEARCH STRATEGY ADOPTED

As suggested earlier, the use of a mixture of methods (involving both quantitative and qualitative data) was seen as the most valuable strategy. This strategy is often referred to as "triangulation", defined by Cohen and Manion (1986) as "the use of two or more methods of data collection in the study of some aspect of human behaviour". (p.254). The value of triangulation is discussed by a large number of commentators on method, including Denzin (1970), Faulkner (1982) and Yin (1984). Faulkner's argument, for example, that each method can "present the researcher with a different vantage point" is a vital element in a study of employers' needs. It has been claimed that "statements by employers cannot always be taken at face value" (Central Policy Review Staff, 1980). The use of triangulation can assist in examining the suggested discrepancy between employers' statements and their practices.

Following on from the above discussions then, it was decided to adopt the following methods of inquiry though not in as linear and sequential a fashion as the list below implies:

- an examination of the relevant literature and existing research in this field
- exploratory interviews with a small number of employers
- continuing interviews with a larger sample of employers
- a postal survey designed for national distribution to a much larger sample
- detailed case-studies of a carefully selected, small number of employing organisations.

The details of the inquiries and their findings under each of those headings are given in the chapters which follow.

CHAPTER 8

EXPLORATORY WORK: SETTING PARAMETERS, DEVELOPING METHODS AND IDENTIFYING ISSUES.

INTRODUCTION

The general aim of the inquiry was to investigate the needs and requirements of employers in terms of information technology and to bring out the implications of those needs for education and training at different levels. In surveying previous work in this area, it became apparent that no similar inquiry (in the field of IT) had previously been carried out. It was clear therefore that no previous inquiry could be directly built upon in providing guidelines on scope, sampling, and methodology in this particular area, although important lessons could be learnt from previous studies (IMS, 1986; Townsend, 1982; Roizen and Jepson, 1985; Fitzgerald, 1985 etc.). No decision was made a priori on whether to focus only on the so-called hi-tech. industries or to consider also the needs of other industries e.g. service industries. In other words, the scope of the enquiry had to be determined. In addition, it was virtually impossible to decide a priori in so new and rapidly changing a field on the choice of sampling method, the sample population and how it was to be stratified. For example, if hi-tech. industries were to be chosen how were such industries to be defined and how could they be categorised?

The purpose of the exploratory interviews and discussions described below was therefore threefold: firstly, to establish parameters for the employers inquiry in terms of sampling, size (both of the sample and companies within it) and the scope of the inquiry; secondly, to produce a general design for the inquiry which could be adapted; and thirdly, to establish and refine particular methods which could be employed subsequently by myself and indeed others who wish to investigate this field in future. These would be initially developed from the issues (of content & method) emerging from the exploratory work.

In the event, fourteen companies were selected and interviews with either one or two representatives of the company were conducted (the companies are listed in Appendix 5). All of the companies participated willingly and the people involved often gave far more of their time than anticipated. Initially, interviews were planned for half an hour but in practice several were of twice this length. Interviews were tape-recorded and subsequently transcribed, with the help of notes taken during interview. The initial interview schedule (used only as a guideline) was continually reviewed. No prior decision was made on sampling for the exploratory interviews. The sample tended to "snowball" as certain issues emerged and new companies were sought to explore those issues and take them further. Sampling at this stage could best be described as "purposive" (Manion & Cohen, 1986) rather than "theoretical" (Glaser & Strauss, 1967), and was certainly not a probability sample.

In most cases, an employee involved in managing personnel or training in the company was deemed most suitable to be interviewed, although a technical manager was sometimes present and made a valuable contribution.

The key issues emerging from the initial interviews which helped to form the framework for the subsequent inquiry are summarised below, with selected quotations used anonymously.

ISSUES EMERGING

The questions discussed during interview can be divided up crudely under several headings, although discussion often overlapped and switched from one to the other: firstly, the company itself and the nature of the company; selection criteria used; prior skills required, in particular in information technology; skill shortages and the current recruitment situation; views on the education and training systems and their output; and finally, of course, general comments on the company's future, its recruitment policies, the development of IT and so on.

The issues emerging which shaped the subsequent inquiry are discussed below.

The nature of the companies

Several companies were keen to be labelled as "hi-tech. industries", for understandable reasons. For example:

Q: "Would you class yourself as a hi-tech company?"

Interviewee 1: "It's hard to imagine any company in the country which is more hi-tech. really, in many respects. We deal with the extremes."

Interviewee 2: "We are pushing the science right to its limits."

It soon emerged, however, that the label 'hi-tech.' has little descriptive use but is rather used as a term of approval or commendation. The question was therefore dropped, particularly as several of the clearly non-"hi-tech." companies (one retailer in particular) were actively involved in using information technology. The term 'IT' was explored and in particular the company's translation of the term. Some used it readily, to cover their activities in computing and communications, (see Chapter 1) but others were more reluctant at first:

"The term 'IT' is not very helpful, and is rarely used in ------------------."

Another company:

Q: "Do you use the term information technology?"

I: "We don't really. I suppose it's a collective noun, isn't it?"

The latter comment was interesting, particularly as it came from a small software house, the kind of enterprise often seen as part of the front line of the IT revolution!

During the course of interviews, however, the term was accepted (given prior discussion of its meaning) and readily used.

Levels of entry and recruitment

Initially the companies interviewed were selected as those clearly involved in information technology, and those can easily be identified from Appendix 5. However, it soon emerged that those companies were recruiting almost exclusively at graduate level and above to their IT posts. This had key implications for subsequent sampling and also for education (this latter point is discussed later). One large computer company said of its London Division:

> "... most of our recruitment takes place at graduate level. We also take in some school leavers, to work in operating rather than programming ... generally from 'A'-level or perhaps good 'O'-level, starting as a very junior operator with a possibility of moving up to shift leader ultimately. We don't use YTS trainees in our division."

That company recruited computer programmers only at graduate level or above. Why did they need people at graduate level to program?:

> "The skills they need are high level, intellectual skills really - they need an intellectual awareness of the problems of the area they're working in. In addition, the technology has moved on so much that they're dealing with far more complex issues in actual day to day work..... so within our particular environment, there isn't a need for people who are going to be simple straightforward code-cutters and nothing else."
>
> Q: "Code-cutters?"
>
> I: "Yes, bottom-line programmers."
>
> I: "Furthermore, when we recruit these people (programmers) we're looking for people who can move up through the organisation to management level quite rapidly. Again, that's why we look to graduates ... people with the ability to get to grips with new technology, and very rapidly changing technology."
>
> (interviewee denoted by I)

It seemed then that the company's reasons for recruiting graduates were threefold: the sheer demands of the technology; the complexity of the general issues, of which programming is only a part, on which they would be working; and finally, the company's need for people who would progress from this stage to other roles in the organisation e.g. systems analysis. As it happened, these issues would all be reiterated and explored subsequently.

An effort was therefore made in exploratory work to seek out companies from other sectors of the SIC (see Chapter 2) which were not

IT companies but were likely to use IT. This strategy was also used in work described later where a distinction is made between IT providers and IT users (see also IMS, 1986). However, one retailer "purposively" interviewed made the same point about computer programming:

Q: "At what levels do you recruit into computer programming?"

I(1): "We don't have any YTS in programming. The majority of our YTS is in the retail division."

A large, multi-national telecommunications firm made a similar point, but did go on to mention the IT work that would require training at below graduate level:

I: "...we recruit programmers for our development work ... those we take mainly as graduates ... some electrical and electronic engineers, some computers scientists. We don't really distinguish between hardware and software engineers."

Q: "Would you involve any YTS trainees in the computer programming side of your business?"

I: "It's difficult, because the programming that's done in the laboratories is normally part of development work and that tends to be fairly high-level engineering. We tend to use the YTS people as technicians ... I don't think we'd actually have them doing any programming."

"... they (YTS trainees) come in mainly with a view to joining the company as typists, secretaries ...word-processor operators ... mainly girls."

"Some of the boys may work as technicians... if they're good at the job they may join us as apprentices."

The notion of different levels of recruitment and consequent employment in IT was explored further with another company which employed a large number of staff as "operators":

Q: "At which levels does your company recruit in the IT area?"

I: "In terms of actual programming or systems development - if you like, the hi-tech. skills - that would be at graduate level almost solely. It would be very unusual for us to take somebody with a HND but no experience into programming work."

Q: "What jobs do the operators actually do in your company?"
I: "They would be doing things like loading tapes - working in a large machine room - running the operations, probably on shift work .... very basic support role in a large data centre. From that they could gradually work through to develop more experience in operations and ultimately become shift leaders, in a sort of management role."

Q: "Do you require any prior IT skills of those people?"

I: "Not when they first come in, no."

I(2): "The only reason we'd recruit someone if they hadn't got a degree would be if they were working for us already ....There's no external recruitment into programming except at graduate level."

It thus became clear that the whole range of occupations within IT would need to be investigated in the main inquiry if the full implications for education and training were to be brought out. Levels of entry into employment and corresponding jobs in IT would need to be fully examined. In addition, the scope of the inquiry would need to be widened in order to embrace all occupations involving IT. One company in telecommunications engineering, for example, was (at the time) recruiting only graduates.

Prior Skills and Selection *Criteria*

One aim of the exploratory interviews was to begin to examine the prior skills which companies most valued and their consequent selection criteria. This line of discussion again raised several important issues which were subsequently followed up. As discussed earlier (Chapter 2), employers were remarkably reluctant to specify particular skills which they require, particularly in the IT field.

Their requirements and selection criteria were often stated in more general terms:

> "...we are looking for people who have a good all-round education ... they've managed to gain some sort of English qualification, so that they can write and talk in their native language." (Data processing company)

The same company mentioned "ambition" and "get up and go" - personal qualities such as these, as later inquiries show, were mentioned repeatedly by employers.

The ability to work in a team and to communicate within that team was stressed at all levels:

> "They've got to be people who can fit in - people who can work in teams ... people who are capable of getting on with the customer, who could represent the company. These are as important as technical ability."

The same employers, in talking of graduates added:

> "The whizzkid who can't communicate - we don't like him. The whizzkid who can communicate....yes please." (Large electrical engineering company)

> "We are certainly looking for people who can work in teams. We operate a thing called the 'ship system', with a captain and a team working for him - that's the ship." (Manufacturer)

> "They've got to be able to get on with other people, to work as part of a team .....they've got to be an amicable sort of a person really." (small software house)

A statement of specific skill requirements in IT was not forthcoming from any employers. This seemed to relate to three factors: firstly, the presence of a training programme within the company to provide specific skills; secondly, the sheer rate of change of the technology and of the companies using it:

"Needs are changing quite rapidly, aren't they? The company I work for is unrecognisable from the group it was ten years ago. All we can say is that generally we need a bigger choice of high-calibre, good applied science graduates ... and I think that is the nearest we can get in saying what we need in ten years time." (electronics firm)

Thirdly, certain employers insisted that what they required was general aptitude and, more particularly, the ability or "aptitude to acquire new skills" (one electronics employer).

Some of these points are summed up vividly by the following transcript of a conversation with an employer not directly involved in providing IT but in using the technology with retailing:

I(1): "Basically, we're moving and changing so quickly, it would be very hard for education to keep up. If you taught all 15 year olds our laser scanning system they'd soon be out of date - we're looking for a new system already."

I(2): "Although we've made major advances in the last few years, to be quite honest it hasn't affected the sort of person we're recruiting. From a branch point of view, we need the same skills now, even though we've got the computers there, as we did 10 or 15 yeas ago. What they need to do is interpret data... and they've been interpreting data, albeit in a different format, for ten years. I wonder why there is this emphasis to teach kids about computers? How many of them, when they leave school, are actually going to get hands-on experience?"

I(1): "We're looking for people who will treat customers as human beings ... mix well with their colleagues ... communicate well with customers. Numeracy is vitally important ... a desire to be neat and tidy."

Q: "The people you recruit into retailing, do you require any IT skills of them?"

I(2): "No ...none at all. We don't require any prior skills, we have a lot of in-house training."

This transcript is perhaps most interesting in that it highlights three points to be elaborated upon later.

Firstly, the stress on numeracy, literacy and the ability to communicate which (as subsequent data reinforce) are universally valued by employers; secondly, the seeming paradox (discussed earlier in Chapter 2) that in a technological age personal qualities are deemed so important, even by employers directly involved in providing IT - part of this paradox is the view expressed above that the abilities sought now are often the same as those sought fifteen years ago. Finally, the rate of change of technology in employment makes it virtually impossible for "education to keep up". It also makes the employers' task of specifying their requirements with any precision increasingly difficult. What implications does this have for education and training in information technology, or indeed vocational preparation generally? What are the implications for a programme based on skills?

Skill Shortages and patterns of recruitment

All employers in preliminary interviews were asked about their skill shortages and recruitment difficulties. Answers in this area again indicated general issues which were to be examined more fully later. One employer questioned the notion of a "skill shortage":

> "I don't think we talk too much in terms of skill shortages, do we? We define it more in terms of having the right people at the right time."

Other companies, particularly those who classed themselves in the high-tech. category, did use the notion of skill shortage although several claimed that their shortages were either at a high level or in a fairly specific area:

> "We do talk about skill shortages, very much so ... but much more on the software development side, and there we're talking about the skills needed to operate within an ICL-kit environment. So the skill shortages are really a question of experience within the industry."

One Engineering company expressed disappointment at the poor number of graduate applicants at that time, despite the higher salaries offered - computer science & electronic engineering were seen as the most difficult disciplines. Similarly, an electronics firm felt that the key shortages were only at the higher levels:

> "I think it's extremely unlikely that the YTS type area is going to affect the hi-tech. shortages - I just don't think it's geared at that level."

Specific shortages were also mentioned by a manufacturing company:

> "We're very short of Metallurgists, at graduate level. We also need more electrical and electronic engineers. Our requirement for Metallurgists this year is 40".

The issue of skills shortages is closely connected (both as a cause and an effect) with patterns of recruitment. The majority of the firms in the exploratory interviews felt that graduate recruitment was on the increase with diminishing demand for people at lower levels in some cases. For one large electronics organisation:

> "...the trend is upwards, increasingly, towards taking graduates into areas which hitherto wouldn't normally recruit graduates. That's both into specialisms and also into some of our companies which wouldn't have normally employed graduates."

Despite the trend over the last decade in manufacturing industry towards a smaller & smaller workforce (documented in Chapter 2), the level of graduate recruitment of one manufacturer had remained constant in that time:

I: "...graduate recruitment has remained very constant over the last very many years at about 240 or 250. Our manning has come down from a quarter of a million or so in the early '70's to 60,000 now ... but over that period we've still kept our graduate intake at, well, healthy levels."

Q: "How could you explain that?"

I: "...well, because, sadly, people who have been going out of the industry have been people at the lower end of the intellectual scale ... people who've not had high qualifications ... people in the works, in our melting shops, in our rolling mills, in our finishing banks. The people who've gone have been the less skilled people ... but we still recognise the need for people with high qualifications and high ability to help us run the industry in the future. So we still need a couple of hundred graduates every year for the future."

Personnel managers were well aware of growing concern over graduate shortages in certain disciplines. In the light of graduate shortages, would they recruit at lower levels? Several interviewees said they would not. One electronics company (American owned) was already seeking graduates of any discipline to train as systems engineers ("part way between programmer and systems analyst"), provided that they have "a proven interest in data processing, with normally a part of their course being connected with computing." (this comment clearly has implications for the integration of IT into education which will be followed up later).

One employer gave an explanation of his intention to continue recruiting at graduate level even if shortages in key areas became more acute:

Q: "If you couldn't get enough graduates for your requirements would you look to new training schemes then?"

I: "We'd probably do what we've already done, which is to pull in graduates from other disciplines, i.e. not the sought-after disciplines, after some testing to try and select and convert them.

"I think it's very difficult to see how the academic level of the YTS people could assist the hi-teh. companies in their research and development." (electronics company)

The technical and personnel managers of a large electrical engineering company offered their own lengthy explanation of the trend towards higher level recruitment in new technological industries:

I(1): "...we must be moving towards a high degree of automation in British manufacturing industry if we want it to survive - employing a few people at a high level of skill, and a very few people at a lower level. To rely upon British manufacturing industry to provide more jobs is, I think, a misconception. Maybe we should be educating people for leisure."

I(2): "...it's a move towards more automation, though not because we want to do people out of jobs. The move is because we want a higher level of product quality, for conservation or whatever - we can't waste materials as we did before. That is the trend. The move is towards requiring a higher intellect in industry to decide what an automation system is supposed to do."

I(2): "The people employed in maintenance now, their academic requirements have gone up. We now have a large number of graduates working in the maintenance area - also the people on the production side, running the factory. They need to appreciate all the sophisticated equipment they've got at their disposal. They need a higher intellect than before."

I(1): "Traditional craft skills in the electronic & electrical industry are disappearing. Take drawing office work, for example, where a lot of the rules are very well known, documented or in people's heads. These rules can be put into computers - rtificial intelligence I'm talking about knowledge-based systems."

The issue of trends and developments in technology affecting patterns of recruitment will be examined more fully later. The other issue - that a "sideways" move in graduate recruitment may result from graduate shortages in key areas rather than a downwards move towards lower level recruitment - will be discussed again in the light of evidence gained in the full survey and later in the case-studies. This also raises the question of the extent to which graduates are fully stretched or exploited within a company - are they doing jobs which could be done equally well by non-graduates? This issue is explored particularly in three of the case-studies.

OTHER ISSUES EMERGING

A number of other issues emerged in exploratory interviews and discussions which were by no means expected. Criticism was made of the education system at school level, especially in three areas: careers advice, shortages of maths. & physics teachers, and gender divisions at the age of 14. These were therefore followed up in the subsequent inquiries described in Chapters 9 and 10.

Two engineering firms were particularly forthright in criticising careers education at school level. One complained about the poor image of engineering compared with pure science, and of course the "professions":

> "Engineering is still thought of in many places as a dirty-hands, mucky sort of occupation."

Good careers advice and discussion, particularly to girls, was seen as a priority.

The issue of the shortage of maths. & physics teachers arose more frequently than expected. Several employers felt that this was one of the root causes of the shortages discussed earlier. For example:

> "...what worries me at the moment is the lack of physics teachers in schools. A lot of our kids are never even going to get an electronics interest." (large electronics company)

The necessity for geographical mobility of the future workforce was also an issue which emerged. Interviewees felt that the onus should be on recruits to be mobile rather than for firms to relocate. The growth of the so-called sunrise industries in information technology was discussed by one employer. When asked if Britain should encourage IT industries to re-locate in parts of the country other than his own (in the Thames Valley):

I: "I think the frightening thing is that the kind of jobs we're talking about are concentrated in a particular part of the country, like the Thames Valley."

Q: "Why do you think that is?"

I: "I guess it's to do with being a pleasant part of the country, very good international communications ...I think the trigger was the development of new establishments, down the M4, like Harwell and Aldermaston and all these places. New industries, often defence-related, moved in around them. Then, of course the American multi-nationals came in, looked at it and liked it."

Q: "How could Britain encourage more hi.-tech. companies in other parts of the country?"

I: "I really, honestly think that we've got to see it in national terms, not regional terms. The depressing fact (speaking as a Northerner) is that it probably makes sense in national terms if the market is left to itself ... there's a market economy worldwide - if we try by grants and re-direction to put people in places they don't want to be, they won't go to Sheffield or Liverpool ...they'll go to somewhere in Europe where they want to be. It's a truly international business. There's been this kind of concentration in particular areas in America as well of course. I really think we have to let it happen."

If this interviewee's analysis is correct, then it has serious implications for recruitment patterns and training needs. Almost by definition, graduates from higher education are geographically mobile and are therefore immediately capable of fulfilling one requirement of the modern workforce in IT industry. Where does this view leave the ITeCs scattered throughout the country but far more geared to local needs and local industry than the universities and polytechnics?

A final issue which has been the subject of much debate in the literature (see Aleksander, 1986, for a particularly poignant summary) is the influence of developments in information technology itself on the need for IT skills and the nature of those skills. This issue was raised particularly by one retailer interviewed whose company invested massively in IT. A "skill pyramid" may emerge in information technology in which a small number of people at the top are involved in producing IT systems (hardware and software) for a much greater number of people at the foot of the pyramid. The situation in retailing described by this interviewee is perhaps a microcosm of that trend:

I(1):"...our computer systems are designed so that they will be easy to understand and use. To that end we have branch managers involved at every stage in the design of programs. They say: "this is the information we need - you, the few experts in the ivory tower provide it in this format". That's why IT skills aren't required in the branches. Systems are designed for people who have to use them, they're user driven."

Q: "So they're designed for people without IT skills by people at a high level with IT skills who can make those 'interfaces' if you like more user friendly?"

I(1): "We're removing the need for IT skills."

I(2): "The emphasis has always been that the manager is there to manage - he is primarily a grocer."

"The technology will develop ... but it will still just be a matter of interpreting data. We will have point-of-sales debiting in 15 years time, but there will be less contact with computers because of that."

I(1): "EFTPOS (electronic funds transfer point of sale) will come in - once again it will have to be designed so that every customer can use it, and all our staff can use it."

In short then, IT will be developed for the customer, not the customer for IT. This is perhaps the modern version of "the customer is always right."

SCOPE, SAMPLING AND METHODS

As a result of the exploratory interviews and emergent issues described above, certain important decisions were made on scope and sampling which affected the whole of the subsequent inquiry.

Firstly, it was decided to involve the whole of employment, right across the Standard Industrial Classification, both in subsequent interviews and in the postal survey. This was largely because the so-called IT providers were so biassed towards graduate recruitment - the use of IT in employment in all sectors, and consequent recruitment, therefore needed to be covered in order to bring out the full implications for education and training.

Sampling in the early stages, as mentioned earlier, was largely "purposive" in establishing the parameters, framework and methods for the subsequent inquiry. The exploratory interviews showed that sampling needed to be more systematic subsequently, and indeed a method of probability sampling was used in the postal survey (described fully in Chapter 10).

Finally, the exploratory work pointed both to a research strategy and to the most fruitful ways of conducting research and analysing data collected. The interviews proved to be of immense value in allowing open-ended discussion, exploring particular issues and generally permiting interaction between two or more people. They did not, however, allow stated views and perceptions to be examined in the context of the employing organisation or to be compared to the statements of others at different levels or in different parts of the organisation. This reinforced the need for a small number of case-studies to allow emerging issues to be explored in context and in greater depth, and to be supported by observations, documentation and other evidence (see Chapter 11).

On the other hand, however, only a limited number of organisations can be reached by interview (given the usual constraints of time and money). It became clear that a number of important issues could be more broadly (though more superficially) explored by designing a follow-up questionnaire and collecting data from a wide range and large number of employers (see Chapter 10).

What the exploratory study did allow with some satisfaction was the development of an interviewing approach and a flexible, open-ended schedule which could be used in subsequent research not only by myself but also by other workers. In addition, an approach to analysis was developed. Each interview was tape-recorded and subsequently transcribed with the aid of notes as soon as possible thereafter. This proved to be more satisfactory than using a secretarial assistant to transcribe the tape. To paraphrase Popper perhaps, one could say that "transcription is theory-laden." In addition the resultant transcriptions were easier to analyse and cross-compare.

In short, the exploratory interviews allowed a "research tool" to be developed which could be used subsequently and was indeed used by the three teacher-fellows involved in contacting employers in the TRIST project under my direction. Indeed, the development of ways by which those in education can approach employers, determine their needs and probe their requirements and shortages was a central aim of the whole enquiry.

CHAPTER 9

IT IN EMPLOYMENT: INTERVIEWS AND VISITS

INTRODUCTION

The exploratory interviews described in Chapter 8, carried out with representatives from 14 companies, enabled preliminary decisions about scope and sampling for the subsequent inquiry to be made and also allowed a tried and tested research interview to be developed. In addition, certain key issues began to emerge leading to headings under which subsequent qualitative data could be analysed. One of the problems with qualitative research is the sheer volume of data collected and the consequent difficulty of analysis (Miles and Huberman, 1984; Bogdan & Biklen, 1985). The exploratory work pointed to headings and key issues under which the subsequent data discussed in this chapter are analysed.

Interviews and their analysis

The interview schedule developed for the work described below is shown in Appendix 4. The schedule was used flexibly, following the approach developed in exploratory work, and room was always allowed for open-ended discussion. Every interview was tape-recorded and transcribed using "field-notes" - interviews were conducted on the employers' premises wherever possible, which allowed some impression of the context to be acquired. Having developed this mode of enquiry in my own exploratory work, I felt confident enough to use the same methods in the TRIST project involving three teacher-fellows. The teacher-fellows were involved in interviewing employers, under my direction, and some of the data presented below emerged from their fieldwork. As project leader, I was able to present my exploratory work to them, discuss the interview schedule, and review data in discussions as it came in.

Analysis of the transcripts of the employers' interviews was strongly influenced by the structures beginning to emerge from the exploratory work described earlier. Using some of the headings from the interview schedule which were common to all interviews certain tables of results (shown below) could be put together from the replies received.

In addition, the sample was not too large to make the simple reading through of unstructured comments impossible, with some interesting comments arising from the employers themselves.

Scope and Sampling

The data presented in Chapter 8 point clearly to the need to examine a much broader range of employers than only the 'IT providers' i.e. those companies directly responsible for producing the hardware and software used in information technology by themselves and others. Thus it was decided that the sample of employers should represent the whole spectrum of employment as well as possible. As with the postal survey described below and the analysis of employment patterns in Chapter 2, it was decided to use figures based on the Standard Industrial Classification. It soon became clear that trying to get a set of employers who actually employed numbers of people in exactly the right proportions was going to prove too time consuming, so the number of firms to be interviewed in each sector on a bar chart was plotted giving each firm equal value. The pattern of the bar chart was made to match the numbers employed in different sectors according to SIC. In addition some extra interviews were included with providers of IT since the aim was to focus on IT in employment and its relation to education, and such companies would (by definition) be most actively involved in IT. It was also decided that there should be a mixture of large and small firms, and that there should be a reasonable geographical spread.

This rather rough "sampling process" therefore provided two groups from the total of 46 employers who were eventually interviewed:

1. A group which represented the distribution of employment nationwide using the Standard Industrial Classification. There are 24 employers in this group, which will be referred to as "The matching sample".

2. A group of 22 extra employers who were mainly concerned with the manufacture and suppy of IT products. This group will be referred to as "The extra IT providers."

DATA COLLECTED FROM EMPLOYERS: PRELIMINARY ANALYSIS

The preliminary analysis of interview data was carried out under the headings used below. As in chapter 8, anonymity is preserved throughout.

Trends in Recruitment at different levels

It was not possible to obtain detailed figures of trends in recruitment as perceived by personnel managers. However an indication of present recruitment practices can be obtained by expressing the actual numbers of people recruited in a given year as a percentage of the total numbers employed. Within the matching sample, the total level of recruitment for that year was 3.2% of the total workforce. It is not possible to produce an accurate figure from the extra IT providers. However Table 28 shows the pattern of recruitment found within the matching sample.

Graduate Recruitment

Among the additional IT Providers it was possible to obtain figures for graduates only, and these were:

Recruited for IT purposes: 5 per 1000

Recruited for non-IT purposes: less than 0.5 per 1000

This gives a total of just over 5 per 1000, which corresponds reasonably well with the total figure in the matching sample.

A figure of just over 3% of the total workforce being recruited each year will barely cover normal retirement, assuming a working life of 40 years. It definitely does not cover normal rates of natural wastage.

At graduate level, there were 80000 graduates in 1984 out of a total working population of approximately 20 million. This gives a figure of 4 per 1000. The evidence indicates that in the small sample above employers are looking for between 5 and 6 graduates per year per 1000 employees. In other words, there is a clear upward trend in this sample of the proportion of graduates in employment. If this proportion of graduates is necessary for the proper functioning of employing organisations, then either the number of new graduates per year needs to be increased by between 25% and 50%, or the number of non-graduates needs to be decreased by between 20% and 33%.

Channels of Recruitment

It was not possible to separate channels of recruitment for IT related work and non-IT related work. It is worthwhile, however, to distinguish between channels for graduate and non-graduate recruitment. The channels for graduate recruitment are shown in Table 29. Table 30 shows the channels used by employers in recruiting non-graduates.

Criteria used in selecting recruits

Only a minority of employers interviewed specified different criteria for different levels of entry: 6 of the 24 firms in the matching sample did so for work not relating to IT. Only one of the matching sample and one of the extra IT providers did so, for work relating to IT.

Some firms specified different criteria according to the work to be done by the applicant if employed, but the numbers again were small: 3 out of 24 in the matching sample for work not relating to IT, 2 out of the matching sample and 2 from the extra IT providers for work relating to IT.

It is therefore not a useful exercise to try to separate the criteria used at this stage. Table 31 below sets out the criteria mentioned more than once in any of the three groups or more than twice across all three groups.

A comment needs to be made on the entry "academic qualifications". The overwhelming majority of those interviewed by firms in the survey had already been selected according to academic qualifications, since employers had specified to potential recruits the academic level required. Selection procedures were therefore taking place within pre-defined bands of ability, and the further mention of "academic qualifications" refers to selection within those already narrow ability ranges (detailed discussion of levels of recruitment and their relationship to selection criteria is given subsequently).

Recruitment difficulties and skill shortages

The majority of employers interviewed stated that they did not experience difficulty in recruiting staff at any level. This was often said with regret - the impression often being given that they would be pleased to employ more of the many high quality people who apply to them for what vacancies there are.

However when particular difficulties in recruitment were mentioned, personnel and training managers had no difficulty in stating what they were, often with considerable feeling. Table 32 shows the difficulties perceived in both groups of employers.

In common with many previous surveys and the exploratory interviews the impression was gained that there are more than enough good quality people of ordinary talent to fill any vacancies available but that some organizations are hampered by a lack of particular specialists, often requiring high qualifications or other very specialised skills.

Reasons given for difficulties experienced in recruitment (where these occur)

A total of 19 different reasons were given and 12 of these related to aspects of the education system. These will be incorporated into the next section, which deals with employers' comments on education and training. The remaining seven reasons are listed below in no particular order:

1. Low pay, linked to national or industry-wide pay scales.
2. Location in Northern England.
3. Unsocial hours of work.
4. An increasing reluctance on the part of young graduates to undertake weapons-related work.
5. The "attitude of society" to girls in science and engineering.
6. The "attitude of society" to anyone working in productive industries, particularly in engineering.
7. Incursions by multinational corporations into the British graduate market.

Two other comments also emerged at this stage which are relevant to recruitment generally:

1. Shortages in skills below graduate level often disappear very quickly with the advent of new technology.

2. The attitude of new graduates towards an industrial or commercial environment has improved considerably in the last two years or so.

Employers' comments on education and training

It was observed in the previous section that many comments on the nature of our education and training system were made in relation to difficulties experienced in recruiting. These comments have been added to the comments made by employers during this part of their interviews.

Not surprisingly, the comments received on the education and training system were very varied. However, it proved possible to group them and then place these groups in the order of frequency in which such comments were made. Table 33 summarises the types of comment made by employers on education and training.

The following remarks and statements provide a sample of all the comments made by employers on the education and training systems under those categories. If a comment occurred more than once, the number of occurrences is placed in brackets at the end of the comment.

GROUP 1: The relevance, or lack of it, of courses *at all levels to the* needs of Industry and Commerce.

> "Higher Education is not paying attention to the needs of industry"(2)
>
> "Polytechnic degrees have a better approach to industry's needs than University ones".
>
> "Too many arts graduates."

Politicians take a short-term view in regard to industry's training needs, resulting in inadequate funding in crucial areas.(3)

Lack of commitment by government to training.

The importance for industry to maintain in-house training at all levels (2)

The need for the use of more practical applications in education.

The need for continuing government support for training in leading-edge technologies particularly when conducted in-house.

The particular importance of the Alvey Directorate and the Software Support Scheme for Industry.

GROUP 2: The need for IT to be part of general education

> "There is a need for young people (pre 16) to be exposed to, but not highly trained in industrial and commercial IT". (3)

The importance of linking IT with existing curricula. (2)

Graduates of any dicipline can take to IT if they have been given the confidence to do so earlier in life. (3)

The need for all clerical staff to overcome any fear of IT technology.

IT "as vital as reading or writing".

GROUP 3: The lack of suitably qualified teachers in IT related subjects.

Poor teacher training in Electronics and Computing resulting in poor work in schools. (2)

Lack of Physics teachers in schools. (2)

Inertia in the education system in tailoring courses and their syllabuses to the needs of industry. (2)

Computer specialists not attracted to teaching due to low rates of pay. (2)

A levy should be made on employers of mathematicians, science and computing graduates and this levy should be used to increase teaching salaries in these areas.

GROUP 4: The Importance of a good basic and general education.

Poor levels in English and Maths. (3)

Importance of English and Maths. (1)

Concern that pupils can drop science at 14. (2)

GROUP 5: Poor advice to pupils, especially girls, about IT.

Criticism of the careers service. (3)

Criticism of the careers service with respect to girls. (1)

Typecasting of girls worse in primary than in secondary education.(1)

GROUP 6: Satisfied with the system as it stands (4)

GROUP 7: The usefulness of YTS. (4)

GROUP 8: The Incorporation of teamwork into education.

The need to find a way for degree students to take part in team projects and still be assessed individually. (2)

Encourage teamwork activities outside a students academic work. (1)

The need for cross-curricular application skills in schools. (1)

GROUP 9: The need for IT awareness amongst management. (3)

GROUP 10: The Provision of IT equipment in schools.

One computer per school useless, 30 per school "impressive". (1)

> "It is a matter of convincing the people who hold the purse strings that you have to write off computer equipment within a period of time". (1)

School equipment not high-powered enough. (1)

GROUP 11: Doubts regarding the exam system.

School exam results not always a true guide. (1)

The usefulness of competence objectives within school courses. (1)

GROUP 12: The expense of commercial training programmes. (2)

Other comments made during interviews were related to:

- The EITB (Engineering Industry Training Board) needs to bring its training course up to date.
- The usefulness of the apprenticeship system.
- The need for young people to be trained in interview techniques.

Employers' Views of the economy and its future prospects

Twenty-four views were recorded, nearly all of them from the matching sample. The essential messages behind these views are listed below in order of frequency:

1. The need for a stable manufacturing base to the economy, and concern over the poor image of the wealth-creating and productive industries in this country. (7)

2. Concern for the plight of the unemployed, linked to a sense of frustration that so much talent and training was being wasted. (5)

3. Recognition that most of our industries are small by world standards and that we need to find niches in world markets. (4)

4. The dangers of multinational corporations exerting undue influence on national trends and policies. (3)

5. The need for government help in the development of new schemes both financially and by cutting red tape. (2)

6. The social effects of the North-South divide: "Frightening" said two, "but inevitable" added one of them. (2)

7. The need to employ fewer people in industry, as has already happened in agriculture. (1)

It is also worth noting that the six companies from the matching sample who considered the future to be difficult were now investing in high technology, and determined to continue, while the four optimistic companies had already invested heavily in it.

DRAWING CONCLUSIONS FROM THE EMPLOYERS' INTERVIEWS

It is not an easy task to discern clear patterns and messages from such a wide range of interviews, covering so many facets of employment (from agriculture through manufacturing to the service industries), with opinions often expressed by individuals with strongly held views. Indeed, the willingness to talk at length and express opinions, along with obvious loyalty to the organisation represented, were the two most impressive features common to all interviews.

It would also be unwise to suggest that generalisations can be made from such a small proportion of the total number of employers. However, many of the companies visited were leaders in their own sector whether it be retailing, manufacturing, engineering, catering, semiconductor technology or services. It does seem acceptable therefore to draw certain conclusions from the interviews which could provide valuable guidelines for the education and training systems. (These will be elaborated upon in chapter 10, having considered the data collected in the postal survey).

Graduate Recruitment

Firstly, there does seem to be an increasing trend towards graduate recruitment amongst both IT providers and IT users. To quote from one large manufacturer seeking engineers:

> "Everything seems to be picking up at graduate recruitment level. A colleague of mine was recently in Southampton (University)...I think there were 15 unsponsored engineers graduating...they had over 100 companies calling to see those 15...we were one of them!(laughs)."

Similarly, other employers e.g. a large international electronics company, described a "very clear trend towards a more professional, highly-skilled workforce" with an increasing proportion of graduates. In programming, for example, a number of organisations interviewed stated that programmers were now only recruited at graduate level, as indeed the exploratory interviews made apparent.

This trend clearly has implications for the output of higher education and for the content of courses in IT at earlier stages.

Selection Criteria

Secondly, there are certain messages for the education system in the selection criteria used by employers. As detailed earlier, great emphasis was placed during interview on the importance of being able to work in teams and to relate to other people. It is perhaps ironic that in a time of increasing use of technology the stress from employers upon the value of inter-personal skills is clear and common to all sectors. In engineering for example:

> "We do look for people who will make a good member of a team...that they will not be insular. If they can't communicate at all, they're no use to you". (SIC, Division 3, 35,000 employees).

Their emphasis on inter-personal abilities was commonly sought in recruits from school-leavers to graduates. There is a clear message here for the curriculum (explicit and hidden) of courses at all levels, not least higher education.

Employers' Requirements

Thirdly, a general point can be made at this stage (to be followed up in the next chapter) on the requirements of employers and the terms in which they are stated. Far greater emphasis was placed on the need for general abilities and qualities, along with personal attributes such as appearance, enthusiasm, commitment and ambition than on SPECIFIC SKILLS. Indeed, one wonders if the language of "skills" and "skill shortages" which so often pervades discussion linking education and employment (Chapter 3) is either useful or appropriate with a rapidly changing labour market. The emphasis in employers' selection criteria was overwhelmingly on the need for personal attributes in a new recruit: flexibility, initiative, reliability, honesty, interest, enthusiasm, ambition, leadership, commitment, ability to communicate and work in a team, were all stressed highly. Specific skills received little emphasis, although in their rare bouts of specificity some employers did suggest that keyboard skills might be valuable.

Employers were at their most specific and unanimous in demanding two things of school-leavers: numeracy and literacy. This was seen to be part and parcel of what one large employer described as "a broad-based, general education". For example, one large employer in the service sector felt that:

> "We like them (recruits below graduate level), to be able to understand and comprehend...to be literate and numerate...we don't require any prior skills, we have a lot of in-house training. Basically, we're moving and changing so quickly, it would be very hard to keep up."

This was a message expressed in many interviews: that the pace of change increases the need for a "good, general education" (rather than a narrow skills-based approach) and the development of personal attributes such as flexibility, enthusiasm and willingness to learn.

As one public service employer put it:

> "Each employer is after something different...given a sound base, people are then trainable...we prefer our people coming in with the 3 R's and we will TRAIN them, in-house."

This plea for a sound educational base, and the lack of emphasis on specific skills, surely has implications for the future development of technological and vocational education.

Shortages

Finally, the perceived personnel shortages are worth discussing briefly at this point. It is now well established that the output of graduates in science, technology and engineering disciplines has been too low for a number of years and is likely to be inadequate in the near future (see, for example, IMS, 1986). The past supply shortage has resulted in the key problems identified in some interviews e.g. attracting and keeping systems analysts with 4-6 years experience. It has also helped create the "poaching" between firms for key staff at high levels with experience which so many IT providers interviewed (in both private and public sectors) readily noted.

In the future, however, it seems that some employers may be increasingly considering graduates with apparently non-technical backgrounds for IT related posts. For example, the large data processing company mentioned in Chapter 8 will recruit graduates from ANY discipline provided they have "a proven interest in data processing" and a "part of their course has been connected with computing". A large electronics firm in the Thames Valley stated that if graduate supply in the "required subjects" was not large enough they would turn to graduates from other areas, e.g. arts or social sciences, and convert or retrain them. They would not seek to satisfy their requirements in IT by recruiting below graduate level.

A similar move was made by the BBC in 1986 which received publicity in the national press. Having failed to attract sufficient engineering graduates to apply for their vacancies, the BBC posts were made available to arts graduates who would be converted and trained. A large number of high quality applications was received which led (apparently) to satisfactory appointments.

It seems then, that there is "an upper" limit to the demand for computer science, technology and engineering graduates. Many firms are willing to pay attractive starting salaries (between £8,000 and £9,000 p.a. in 1986) to entice them. But other firms can not, and often will not, join in the shortage subject competition. According to evidence from interviews, a few firms (particularly at the "soft" end of IT) are beginning to question the need for (say) computer scientists. However it must be repeated that the movement is horizontal, across the graduate output, rather than downwards to levels below graduate.

This horizontal trend across the graduate population has implications for both school teaching and higher education. Firstly, it may be the case that industry's demand for maths and physics graduates is not insatiable. Questions are being asked of the high starting salaries being offered particularly as they affect a company's salary structures. In addition the need for graduates of a purely technical background is being questioned particularly in jobs involving the use and application of IT. The current acute supply shortage of maths and physics teachers to schools, therefore, may have reached its lowest ebb though this is an optimistic view. Another crumb of comfort for schools from the interviews is the great concern and awareness shown by employers of teacher shortages. This was seen as a major problem for the future of industry, particularly in IT. Again, this may be false comfort as there seems little doubt that whatever the terms offered to teachers, enterprising industries will better them.

In higher education, if (as the interviews indicate) there is a trend towards recruiting graduates from a wider range of disciplines into IT related jobs, then the use of IT across the curriculum should be enhanced and encouraged. To encourage the use of IT in higher education in every subject area, non-numerate and numerate, will certainly be vocationally valuable and may prove to be educationally desirable. Information technology must not be confined to the numerate and scientific disciplines, according to the evidence above.

CHAPTER 10

IT IN EMPLOYMENT- THE POSTAL SURVEY

The interview study described in Chapter 9 provided an excellent basis for a wider survey of employers' requirements in IT. This survey was carried out using a questionnaire distributed by the traditional mail service. The aim of the postal survey was to follow up and generalise upon the issues emerging in Chapters 8 and 9.

ISSUES EXPLORED IN THE SURVEY

In the postal survey the following specific questions and issues were explored:

1. The uses of IT most common across the whole range of employment.
2. The general recruitment policies of employers i.e. the numbers recruited at different levels.
3. The recruitment policies of employers specifically into IT related jobs at all levels.
4. The prior requirements and selection criteria of employers, firstly in general and secondly into IT related posts.
5. The perceived skill shortages of employers both now and in the future.
6. Finally, an open forum was provided to allow employers to express their views on the education and training systems.

The questionnaire used, which followed these issues closely, is shown in full in Appendix 6.

NOTES ON SAMPLING AND RESPONSE RATE

Postal surveys of this type have two particular difficulties, both of which were experienced in this case:

a. Due to the large number of different types and size of employers in the U.K., the lack of any fully comprehensive catalogue listing of them, and limited funds, of a short-term project, achieving an adequate and representative sample is particularly difficult.

b. Contacting organisations (albeit through the Personnel Manager) with a view to surveying them is by definition more impersonal than surveying individual, private citizens. This impersonality clearly has a large effect on response rates. (e.g. a 1982 EOC project relating new technology to women's employment reports a response rate of 1.2% - see Huws,1982).

The aim of the postal survey was to achieve, as far as possible, a representative sample by means of a stratified sampling procedure. Employers were stratified according to the nature of their business (using the SIC categories) and their size, as measured by number of employees. Full details are given in Appendix 7.

Just under 1000 questionnaires were finally mailed out. In reply just over 200 fully completed, usable questionnaires were received, 10 letters saying IT was not used in the organisation (though the questionnaire was designed for ALL types of organisation - not just those using IT), and 20 returned due to the questionnaire having been sent to the wrong address, or the organisation having been in the hands of the official receiver.

RESULTS OF THE SURVEY: A PRELIMINARY ANALYSIS

Employers' use of IT

Ninety per cent of employers were using IT "in any way", and not surprisingly those who did not were almost entirely small operations (as defined by the sampling stratification procedure). The median number of employees in organisations using IT was 250; in organisations not using IT it was 30. The functions to which IT was used in an organisation elicited a wide range of different responses which on the whole fell into one of nine categories:

1. Accounts; Income/Expenditure; Orders; Invoices; Credit Control; Financial; Purchasing; Consumer Records; Costing.
2. Salaries; Payroll; Pensions; Personnel.
3. Personal Computer facilities; Office Technology; Secretarial; Communications/Information; Word Processing (WP)/Office Mechanisation & Automation; Mailing Database.
4. Sales/Marketing.
5. Production; Production Control, Planning; Manufacture.
6. Stock; Stock Control & Planning.
7. Data Processing; Databases; Programming; Spreadsheets.
8. Management Communications, Information & Control Systems.
9. CAD/CAM; Design; Simulation; Modelling.

The frequency with which each of these categories was mentioned, together with its percentage is presented in Table 34.

Sixty-seven per cent (categories 1,2,3 and 7) of the uses mentioned referred to what could be categorised 'low-level', data retrieval functions, and only 8% (categories 8 and 9) referred to 'higher-level' uses. Categories 4,5,6 were somewhat ambiguous as to the level of IT usage, although they would be more likely to fit into the 'low-level' category of data retrieval. The predominance of 'low-level' IT usage is perhaps to be expected, but of itself it does not reveal much about the implications for differential employment opportunities. Organisations were therefore asked about their recruitment and employment policies.

Recruitment at various levels

Table 35 shows the number of new recruits in a "typical" year, both generally and for specifically IT-related jobs, according to five levels of educational intake.

It must be pointed out that since TABLE 35 is a presentation of EMPLOYERS' needs, it represents solely the DEMAND side of the labour market. For both pairs of columns, the available SUPPLY of labour in each category increases as one goes down the table. From the EMPLOYEE's point of view therefore, the probability of being recruited decreases.

The differences between the two sets of columns is striking, and indicates that organisations operate a significantly different recruitment policy for IT-related jobs than for general work; IT related jobs still seeming to be very much the preserve of the better qualified and educated.

IT jobs done at different levels

It was suggested earlier that the listing of uses of IT mentioned by employers gave no real indication of the implications for employment. The section above, while outlining the extent of recruitment from different levels, included no information about actual tasks performed at each level. TABLE 36 (i & ii) however, contains two sets of proportions relating to this question: the percentage at each IT recruitment level performing certain IT tasks, and the percentage of recruits in each task category recruited from each level of education. The six categories of IT task for this analysis are as follows:

1 = Systems Analysts, Engineers, Software Engineers, Designers etc.

2 = Programmers

3 = Management Administration & Planning

4 = Operators

5 = Secretarial, WP, Stock Control, Clerical & Office VDU Users etc.

6 = Data Preparation, Data Entry etc.

The trends in these tables are clear, albeit not altogether unexpected. The presentation of the data from Table 36(i) in graphical form make the trends even clearer (see Figure 10). They confirm that the level of education reached by recruits is positively co-related with the level of IT work required of them. For example, the chances of performing "lower level" IT tasks are far higher at YTS level than at graduate level. Such a pattern is familiar in traditional working environments, but it could have been expected to have been less marked in areas of IT usage. That these trends are so strong has implications for the education and training of young people. For instance, to train young people in school to a high level of computer literacy believing that this will make them more employable, may be a mistaken view. The evidence suggests that even if this hypothesis were true, they would be likely to be performing low level, easily learned tasks. Employers seem to be recruiting directly from the higher educational echelons to perform the more advanced IT tasks.

This situation is borne out in the data collected on employers' prior requirements of recruits at different levels, which are now considered, and also in their comments in the "Open Forum" section of the questionnaire.

PRIOR REQUIREMENTS

Selection criteria

Employers were asked about their criteria for selecting recruits from each level of the education system. The question was deliberately kept open so that presuppositions and hypotheses would not strait-jacket employers' replies. This resulted in a wide range of responses which had to be categorised and coded "post-hoc". In analysing the varied responses of employers the selection criteria which they stated were divided into six categories: Academic Achievement; Personal Potential; Personal Qualities; Personal Appearance; General Skills; Specific Skills. These categories were chosen simply because the responses collected fitted most easily into those groups. To give the reader some idea of the selection criteria actually stated which were grouped into those six headings, specific examples are given below:

1. Academic achievement: relevant degree; good general education; numeracy.
2. Personal potential: clear thinker; aptitude; good intellect; willingness.
3. Personal qualities: ability to communicate, to mix with others, to work in a team, to get on with colleagues; correct attitude; motivation; enthusiasm; personality; breadth of interests.
4. Personal appearance: pleasant appearance, smart appearance, etc.
5. General skills: relevant experience in certain areas; general clerical skills.
6. Specific skills: keyboard skills, word processing skills.

Obviously there is some overlap between these groups and some fairly arbitrary decisions had to be made on which criteria should be placed in which groups. Personal attributes, for example, were mentioned so frequently that they were sub-divided into groups 2, 3 and 4 above.

TABLE 37 shows the frequency with which the six major criteria were mentioned, weighted by the number of recruits in each section for each employer. Indeed, all the figures in both Tables 37 and 38 are weighted by the following method: whether an organisation mentioned that criterion multiplied by the number it recruits at that level. The percentage in brackets shows the relative importance of each criterion at a given level of recruitment. Table 37 shows that for a graduate hoping to be recruited by one of the employers in the sample, academic achievement was the most common criterion, followed by general skills and so on. It is noticeable that at ALL levels of educational attainment, academic ability is particularly valued by employers, (but especially towards the top of the range). On moving down the range, the relative importance of criteria change. The emphasis is not so much on what one can DO (i.e. categories 1, 5 and 6: academic ability, specific and general skills) but what one IS (i.e. categories 2, 3 and 4: personal potential, qualities and appearance). FIGURE 11 dichotomises the set of criteria in this way and highlights the existence of this differential across the levels of educational attainment.

Further study of Table 37 shows that specific skills have by far the LEAST importance in employers' statements of their prior requirements. At the other extreme, academic achievement including literacy and numeracy figure most prominently, with personal qualities coming a close second (see weighted column totals in Table 37). It could be argued however, that categories 2, 3 and 4 should be amalgamated to form a general group of personal attributes, i.e. potential, qualities and appearance. This broader group would then form by far the largest area of employers' prior requirements.

IT selection criteria

The picture is much the same for IT selection criteria specifically. (see TABLE 38).

The outstanding and significant characteristic of this table compared with TABLE 37 however, is that very few employers require any specific IT skills from the upper echelons of the education system, whereas from the lower levels such skills become more important. A possible explanation of this phenomenon is that recruits from the lower educational levels will most commonly be performing relatively menial IT work (e.g. Word-processing, Spreadsheets, Databases etc). The skills required for such tasks are often transferable from one operating system or set of software to another. At the higher levels of recruitment however (and especially with large employers), many of the required skills (e.g. Programming Languages, Systems etc.) are likely to be unique to the organisation, and as such it takes the responsibility for in-house training of staff.

In-house training

It is interesting that 43 organisations volunteered information on in-house training of staff. TABLE 39 offers comparisons between these organisations and the others in the sample with respect to mean number of employees overall, mean number of graduate recruits, and mean number of graduate recruits in IT.

These figures are interesting and suggest a bias towards in-house training for graduate IT staff.

In this situation, employers require proven intelligence and a high level of educability of their recruits from the higher levels of education. This is endorsed by many of the employers' comments in the Open Forum section of the questionnaire (see below). Table 39 also indicates that it is the larger employers who are more likely to offer a programme of in-house training. (The issue of in-house training and its comparison with outside training is raised again in a more real context in Chapter 11 in considering the case-studies.)

SUPPLY SHORTAGES

Employers were also asked three general questions relating to their present IT staff shortages, the levels at which these occur, and their IT staffing requirements over the next five years. In 34% of responses, employers mentioned that they experienced supply shortages of IT staff. Of these, 67% had occurred at a high level (i.e. Systems Analysts, Programmers, Management etc.), 28% at lower or other levels, and 4% at both levels.

42% of employers foresaw few or no changes in staffing requirements with respect to IT over the next five years compared to 54% who forecast an increase. The latter figure consisted of expected increases in office operators (13%), at the programming/management level (14%), and "general increase" (27%). Only 4% foresaw a decrease in staffing requirement.

Some of the comments given by employers on the changes foreseen in staffing requirements are interesting. The more representative remarks are summarised below.

A number of employers predicted that their prior requirements of staff using IT would change very little. Many foresaw that improvements in the technology itself would allow new and existing staff to adapt to IT and leave to use it more quickly. For example:

> "No changes in staff requirements in relation to IT are expected in the next 5 years - except that the ever-increasing user-friendliness of most common software will enable existing staff to adapt more quickly" (employer in Division 4).

In other words, the technology itself would be adapted to the people using it rather than vice versa.

In no cases did employers specify particular skills that employees or new recruits would need in the future. The most common need or expectation was for greater familiarity with IT:

> "Over the next 5 years there will be an increasing expectation that staff will possess keyboard skills as a minimum and be relaxed in the use of IT i.e. be computerate. Our need for industrial experience of IT will also increase for specialist posts filled by recruits in age range 23-30."

Many employers, particularly in Division 9, predicted that a wider and wider range of staff would be involved in using IT in the future:

> "Increased use of computer systems for many aspects of police work. Increase in use of word processors and micro computers."

> "Gradual increase in the numbers of police and civilian staff being required to use information technology."

Finally, in line with earlier information on levels of staff shortages, a number of employers predicted that their future staffing requirements would be at an increasingly high level:

> "Unfortunately even less vacancies for school leavers, less vacancies for the lower levels of programming. Hardware and development software is fast reducing the need for 'code writing' and intensive operational management. However, the 'expert' in a particular field will be in even more demand."

This point was emphasised by other employers who foresaw a diminished demand for technical programmers:

> "More awareness of business analysis, less requirement for technical programmers. Overall numbers similar to now."

EMPLOYERS' VIEWS OF THE EDUCATION AND TRAINING SYSTEMS: OPEN FORUM

Employers were asked their views on education and training in a very open ended way (see employers' questionnaire, Question 5).

Feelings were mixed about whether the education and training systems were providing employers with the "necessary workforce". 38% specifically stated that they were happy, 24% were not happy (for a number of reasons), 11% made other comments (discussed later), and 27% did not comment at all.

Employers' Views on the output from Education

A small number of employers' answers to the question "do you feel that the education and training systems are providing your company with the necessary workforce?", are singled out below in order to illustrate general points.

Predictably, a number of employers in various divisions were concerned at the output from higher education. Insufficient quantity, in the engineering and technology areas, was the most common complaint:

> "There is a shortage of engineers as the education system is failing to produce sufficient."

> "We suffer from shortages in IT type graduates and behind that in maths and physics 'A' levels."

In the IT area the supply problem was seen to be exclusively at the higher levels with many employers remarking that at lower levels training could be provided in-house:

> "Many more graduates in IT, by a factor of 10. IT graduate courses to be constantly and quickly updated."

> "At the higher levels, the demand does not match supply. At the lower levels on the job training will normally ensure that the basic skills can be enhanced."

Yet again, employers remarked that their prior requirements were not for specific skills but for awareness, positive attitudes, or "computer literacy":

> "At graduate and post-doc. level employees do seem to be becoming more computer literate. At other levels, as far as our institute is concerned, a positive attitude is just as important (if not more so) than experience of IT."

One large employer felt that the output from universities in the IT area was inferior to that from polytechnics:

> "At university level the education system is probably not providing the necessary workforce - ideally more commercial emphasis is required in terms of hardware, software and techniques. At polytechnic level the match is very close to our requirements indeed."

Suggestions on Improving Output

Having been asked for their views and criticisms on the supply of the education system, employers were asked to suggest ways in which the quality and quantity of the supply might be improved, with particular reference to IT. The resounding message was that education should be providing familiarity and awareness of IT at all levels. The only specific skill ever mentioned was in the use of a keyboard.

For example:

> "Education and training in IT must be part of all curricula at all levels. There should be education in using computers as "work tools", and not simply a theoretical understanding of how computers work. Achieving full keyboard fluency would be a major advantage."

> "Having an IT awareness is the only pre-requisite required. Anything to establish this would be to the advantage of the company."

One employer usefully separated long term and short term needs:

> "Long term - computer familiarisation and training should be integral to the education process from the word "go" - possibly even as early as primary level to create total "IT" confidence in population. Short term - encourage training via companies and self development."

In Division 9 particularly, familiarity of ALL staff with IT at EVERY level was seen as the major need although keyboard skills were seen as the only common specific requirement:

> "In terms of non-specialist staff, we will need more and more employees to be able to use basic keyboard skills, regardless of their particular job. This includes nurses, doctors and managers of all kinds."

Practical use of IT was seen as a way of achieving familiarity and awareness, rather than (in the example below) programming:

> "Less programming in education and more practical use of IT."

Many employers went further, in suggesting that basic and fundamental skills and knowledge were more important goals than IT awareness:

> "Re-inforce basic skills in English etc. Everyone has to communicate, even the most technically skilled person. Teach general knowledge in IT, commerce, sociology etc. Co-ordinate school and college teaching with local industry and commerce."

> "A better level of basic and fundamental (sic) tuition is needed."

Pleas of this nature, i.e. for a fundamental and general education providing basic skills, were the most striking feature of the final part of the survey which is now discussed.

Employers' General Views of the Education System

The final section of the "Open Forum" in the questionnaire asked employers to express and discuss their views of the education system. Opinions were expressed copiously, so that only a small selection can be given here (as with all other data, the completed questionnaires have been retained and filed for verification: Stenhouse, 1975). These will be grouped under the main themes and common messages from all respondents which came through in this open-ended section. Those themes are as follows:

Firstly, the need for education to provide specific IT skills is seen as a very low priority by employers. For example:

> "I don't think IT is a big issue. Anybody with reasonable skills and attitudes will soon adjust. We wouldn't recruit "IT qualified" staff deliberately preferring to aim for a good educational standard and ability or previous experience."

> "Our main needs will be met if new employees feel comfortable in front of a keyboard."

This was linked to the second main theme in employers' statements: the overwhelming number who rejected a narrow, skills-based approach to education in favour of greater emphasis on general education and fundamental abilities:

> "I would much prefer the education system producing literate, numerate people with adequate learning skills than pre-packed office fodder - the resulting employees are livelier and more reliable."

This was coupled to the view that companies could provide their own in-house training (discussed earlier in this chapter) in specific skills, provided that employees had a GENERAL understanding and a willingness to learn:

> "The rate of change of technology means that training should be based not on the understanding of a specific technology but on the ability to assimilate and gain an understanding of new technology as it appears. I suspect that this latter training, however, is difficult to 'test' or assess and so is not emphasised in any syllabus."

> "At the end of the day a willing and active mind is worth infinitely more than a knowledgeable one. Since businesses are becoming more and more diversified it suits industry to take pupils on and train them in their way of achieving."

> "IT applications are so varied that one expects to provide the necessary specialised training, for example for the particular word processing program in line. General knowledge of IT seems adequate for our purposes."

A large number of employers emphasised strongly, as mentioned in considering earlier data, the continuing need for literacy and numeracy and their dissatisfaction with present standards:

> "Literacy and numeracy standards still need to be improved all round."

> "We consider that the present education system is falling behind in its teaching of mathematics. Any person who has been taught mathematics properly is quite capable of being trained to use the rather elementary types of computer used by small companies after recruitment."

In particular, abilities such as spelling were stressed - in some cases with feeling:

> "..am often horrified at school products who can't spell, have no better idea of geography than Reagan has, and no good general knowledge, or was it always so. For export and shipping tasks - these are vital to us."

The ability to spell (as with mathematical ability above) was seen as a more important goal for education than the teaching of IT skills:

> "A good typist can be trained to operate a word processor in a few days. The main skills required are typing and the ability to spell."

The themes discussed so far have been the low priority given to prior specific IT skills, the willingness to provide on the job training in specifics, and the constant emphasis on the need for a sound, basic and general education. These interlocking themes were expressed together in one particularly articulate statement:

> "Too much emphasis is put on learning specific items and not enough on developing critical thinking skills. Technology will continue to change society rapidly. It is therefore important that people learn how to apply ideas/knowledge rather than amass particular methods that become redundant. Hence greater care should be taken over basics (including 3R's) in order that people can cope with change."

It seems then, that schools would be foolish to provide a narrow, skills-based approach to vocational education within initiatives such as TVEI. According to the evidence discussed so far the provision of SPECIFIC SKILLS and supposedly vocational TRAINING is not seen as the proper funcion of the education system. When employers did ask for "skills" they almost exclusively mentioned (with the exception of keyboard skills) the more general abilities such as critical thinking (see above) and communication:

> "We very rarely need to recruit specifically trained personnel as we provide specific in-house training as and when required, including computer literacy skills. I do feel there is an alarming trend towards less emphasis on communication skills within modern education and would like to see higher standards of written, verbal and non verbal education in communication skills.

One employer was particularly concerned that training in computer skills would falsely build up the hopes of school pupils and delude them into believing their employment prospects had been enhanced:

> "It is useful for young people to be made aware in the schools of computers, but we must not build up their hopes that they will be employed as programmers/systems analysts."

CONCLUDING REMARKS

This chapter has described the postal survey of employers' policies, practices and attitudes to information technology carried out as an extension to the interview studies described in Chapters 8 and 9. Many common themes were by now beginning to emerge in relation to recruitment patterns and policies, IT tasks carried out by employees, the relation of levels of recruitment to those tasks, trends in the technology itself, and employers' perceptions of education and training.

In the final stage of the inquiry those themes were explored in detail within five chosen employing organisations. Reports on those five cases are the substance of Chapter 11. Before going on to those studies a brief recapitulation is offered below of the main findings emerging from the exploratory work, the employer's interviews and the postal survey.

1. The use of IT in Employment

(a) According to the evidence presented thus far, information technology is primarily being used in office work of all kinds - work which could be broadly termed information processing. Such work includes stock control, accounts and salaries, word-processing, record keeping, financial control, ordering and invoicing and the use of databases of all kinds. In other words the use of information technology appears to have permeated the data processing work of the office to an extent affecting far more employees than the presence of IT in other aspects of employment.

This indication from the sample, if it can be generalised, has clear implications for the future of employment - the effects of IT in its broadest sense, on employment patterns and work practices may as yet be relatively small. In fact, this finding ties in closely with the discussion in Chapter 2 which considered evidence showing that robotisation and the use of IT in manufacturing are as yet not widespread.

(b) Levels of education of employees are fairly closely related to the tasks carried out. Those at HND, graduate level and above are primarily carrying out the tasks of systems analysts, systems engineers, software engineers, designers, and programmers - these are jobs involving what could be called the provision of information technology i.e. designing and setting up systems for others to use. Those involved in using information technology in employment - for example, as operators, in clerical and secretarial work in data preparation and entry - are (predictably) less well qualified. The prior requirements of employers when recruiting for the various IT tasks are discussed in a later section.

2. Recruitment Trends and Difficulties

(a) There is a clear trend in the sample of employers considered so far towards increasing graduate recruitment. This is particularly true of employers recruiting to IT related posts. For example, virtually all recruitment into computer programming is now at graduate level and above. This statement is supported by evidence from the postal survey, the interviews and the exploratory work in Chapter 8.

(b) Graduates are particularly in demand in IT related employment if their first degrees are in computer science or electronic engineering. Attractive salaries are being offered to tempt such graduates, particularly by the larger employers. On the other hand, a number of employers are recruiting graduates into IT related posts - for example as "systems engineers" into one multinational data processing company - although their degrees are not in the computer science/engineering/physics areas. This broadening of IT recruitment across the graduate range has important implications for higher education.

3. Skill Shortages in Information Technology

(a) A crude distinction was made earlier between those who provide information technology for others to use, and employees who actually use the IT for different purposes. It was suggested that employees providing IT are almost certain (according to the evidence above) to be recruited from the higher levels of the education system. This enquiry into skill shortages in information technology indicates that they exist largely at the so-called higher levels such as systems analyst/programmer, or management level. For the IT employers interviewed, the crucial problem was seen as one of obtaining highly qualified staff with at least 4-6 years experience of (say) the computer industry. This is the area where the greatest competition and resultant poaching exists. Some employers, particularly those in the public sector such as health authorities, felt that they simply could not compete with private employers in attempting to attract such key personnel.

(b) Little evidence was obtained to indicate that any serious skill shortage exists in information technology at lower levels. The overwhelming feeling of employers was that they were able to provide their own training in the use of IT e.g. in word-processing or use of a database, provided that recruits had an awareness of such technology, a sound general education, and were keen to learn.

4. Future Staffing Requirements

Similar feelings were expressed by employers in relation to their future staffing requirements in the IT area. Most foresaw an increase in the number of people who would be required to use information technology, particularly in public sector areas such as the police and health services. They did not predict that this trend would create a problem largely for two reasons, one technological and one human. Firstly, the technology itself would become increasingly easy and user-friendly for staff involved in its day-to-day use. As one large retailer put it, it would be the job of the "few at the top of the pyramid to make IT user-friendly and idiot-proof for those on the shop floor". In other words the development of IT itself would bring technology closer to the human rather than vice versa (this view is supported by Aleksander, 1986, for example). Secondly, and as a result of the first trend, people involved in using IT would find it relatively easy to adapt and learn the necessary skills, during on the job training in many cases.

5. Prior Requirements and Selection Criteria

The above views of employers were reflected in their stated selection criteria and their prior requirements of employees. The only specific skill mentioned by employers as a useful prerequisite was keyboard familiarity (this, incidentally, may eventually be made redundant by developments in technology). Those who did mention keyboard skills (a total of 29 in the postal survey) felt they would be valuable at all levels.

Academic achievement is still valued highly by employers. This is true of recruitment generally, and of IT related posts in particular. The value of personal attributes was also stressed highly. These included, in particular: the abilities to work in a team, to relate to other people, and to communicate; enthusiasm, commitment, willingness to learn, and ambition; and finally, personal appearance and presentation. The possession of general skills - especially numeracy and literacy - was seen as far more important than specific skills, such as word processing.

6. Views on Education and Training

This is an area where it is extremely difficult to single out common threads and general signals which might be of value to those in education and training. An attempt is made below to summarise the most common and most constructive messages emerging so far.

Perhaps the clearest message was that courses at all levels should involve more liaison and stronger links with industry, commerce and employment generally. (Suggestions on ways of achieving such liaison were not asked for, although job-swapping and secondment of staff to and from education were mentioned).

Secondly, employers were virtually unanimous in stating that a sound, general education involving the basic abilities of literacy, numeracy and communication was of far more value to them than a narrow skills-based approach. This was particularly true in their discussion of specific skills in the use of information technology. Virtually every employer, in discussion, felt that such skills could be acquired fairly readily by employees (often on-the-job or in-house) provided that the more basic abilities connected with the handling of information i.e. literacy, numeracy and communication, were already present. All felt, however, that awareness and familiarity with IT was a valuable attribute and should be seen as an important aim in education - terms such as "IT awareness" and "computer familiarisation" were commonly used.

Many employers, as discussed earlier, were concerned at the shortage in the supply of graduates in IT and related subjects, such as engineering, mathematics and physics. Some suggested that ways should be found of attracting more girls into information technology at higher levels. Others expressed concern at the teacher shortages in maths., physics and technology which would threaten the future supply of suitably qualified people into higher education and employment.

CHAPTER 11

THE FINAL CASE-STUDIES

PART A: INTRODUCTION

THE VALUE OF CASE STUDY

This chapter represents the final stage in the empirical inquiry into employers' needs in IT. Clear issues are beginning to crystallize at this juncture which surfaced in the exploratory work described in Chapter 8, were reinforced by subsequent interviews and later given clarity and generalisability by the postal survey. The aim of the case-studies described below was to place the key issues in the relation of education to employment in IT within a real, living and dynamic context. This, it was felt, could only be done by some form of case-study. As Chapters 1 and 7 suggested, the case-studies described below could not be described as ethnographies, although they did follow some of the principles of ethnography and face similar problems, such as access.

It was felt that the main advantages of case-study at this stage were as follows:

(1) They would explore the key issues in depth in real settings, issues which had arisen in previous stages of the inquiry.

(2) Case-study would capture a range of important and contrasting perspectives within an organisation e.g. management and operatives; personnel staff and new recruits.

(3) Case-study would probe further behind the rhetoric surrounding IT than the postal survey or interviews had done, by using quotations and observations within one company set in a context sketched as part of the case report itself.

(4) First-hand impressions of an organisation would be provided both from my own perspective and that of employees - perspectives on its traditions, its direction, sense of values, public and private images, and so on.

(5) Finally, only a case-study can capture what is unique about a particular employing organisation, its distinctive features. This perhaps makes case study data 'strong in reality' (Cohen and Manion, 1986, p. 146): "their peculiar strength lies in their attention to the subtlety and complexity of the case in its own right".

CASE STUDY: DESIGN AND METHODS

The full advantages of case study are considered in detail in Yin (1984), for example, and also Bogdan and Biklen (1982); Burgess (1984); Cohen and Manion (1986) and many others. In particular the value of the qualitative research within a study of cases is expressed by Miles and Huberman (1984) who describe it as "essentially an investigative process, not unlike detective work" (p. 37). One of the key reasons for using case-study in this particular inquiry was to begin to develop some sort of explanatory, even theoretical framework, which was firmly "grounded" in the data collected (Glaser and Strauss, 1967). It was felt, with Yin (1984), that case-study would be both descriptive and explanatory - answering both "how" and "why" questions.

Choosing Cases - the logic of selection

Selection of companies in the exploratory interviews (Chapter 8) was largely governed by the need to set parameters and establish a flexible framework for the subsequent inquiry - it could therefore be described as "purposive" (Cohen & Manion, 1986). In the interviews and visits which followed a positive decision was made to broadly reflect existing patterns of employment, using the Standard Industrial Classification, although extra emphasis was placed on organisations centrally engaged in information technology. In the postal survey of a much greater sample, "sampling logic" was applied in deciding on the number of questionnaires to be sent in each of the SIC sectors and the size of companies to be targetted.

The logic of selection of cases for in depth study is perhaps the most contentious. Yin (1984) argues, for example, that sampling logic should not be applied to the choice of cases - Yin's argument against its application to case-study is a long one but can best be summarised in his three main points:

> "First, case studies should not generally be used to assess the incidence of phenomena. Second, a case study would have to cover both the phenomenon of interest and its context, yielding a large number of potentially relevant variables. In turn, this would require an impossibly large number of cases - too large to allow any statistical consideration of relevant variables. Third, if a sampling logic had to be applied to all types of research, many important topics could not be empirically investigated." (Yin, 1984, pp. 50-52).

He goes on to argue that, instead, a replication logic should be used in choosing cases. Yin's explanation of this strategy is again lengthy but perhaps his main theme is that emerging explanations or hypotheses should be put to the test by studying cases. (Yin, 1984, p. 52)

Perhaps Yin's explanation smacks too much of the confirmation of theory rather than the primary function of falsification, seen since Popper (1968) as the essence of the scientific process. However, his essential point that each case should be chosen carefully in order to examine key issues was taken as fundamental in this inquiry. Issues such as the notion of "skill shortages", levels of recruitment, the development of the technology itself, upward trends in graduate recruitment, the demand for personal qualities, continued emphasis on literacy and numeracy, and broad versus narrow-based approaches had all emerged from interviews and the postal survey. All needed to be examined within specific contexts in order to allow any explanatory framework to be credible and "grounded".

The Cases Chosen

Five organisations were finally chosen to be considered in depth and thus to explore key issues. Full details of each organisation, its size, its SIC sector and its function are given under each case description although total anonymity is preserved throughout. Each case was felt to be unique in some way.

The final selection was determined by a number of factors. The case study sample matrix drawn up in Table 40 shows just some of the points considered. Perhaps the key consideration was that the categories of 'IT Provider' and 'IT User' emerging from previous research (for example, IMS, 1986) should be used and examined. Thus 2 of the cases chosen were plainly IT providers and two were IT users. The fifth case (Case C) lay across both categories - its function (reflected by its location in the service sector of employment) is to form a bridge between the obvious IT providers and companies using IT which are its customers. The value of the categories themselves was also examined critically - it soon becomes clear, for example, that IT providers are almost by definition also IT users.

A range of sizes was also considered important as Table 40 shows. It was expected that issues such as training needs, skill shortages, levels of recruitment, involvement, youth training, and so on would be affected by size. Another factor, or rather complex of factors, felt to be of key importance is the general nature, quality or ethos of the organisation. Tradition, long or short, will play a part in this hence the indication of year of establishment in Table 40. One case for example has a tradition rooted in 18th and 19th century values yet has responded successfully to changing times and technology. Another, less than a decade old, already seemed to have established its own identity and values amongst its workforce. A third has a strong, warm family identity with obvious advantages but wider implications which are drawn out in the case report. Each case chosen was distinct in some way in terms of its structures, its values, and its traditions.

Method and Protocol Followed

A full discussion, or even a list, of the skills and tactics most suitable for carrying out an effective case study would be a long one and will not be attempted here. Certainly the skills of observing, listening and questioning are essential, as is a general flexible adaptive, and open-minded approach. A good "grasp of the issues being studied" (Yin, 1984) is another vital prerequisite so that the "capacity to interpret situations" (Stenhouse, 1985) in their broader context is present. The case studies described below involved a combination of observation, interviewing (formal and informal), examination of documents, and discussion - therefore their success depends on at least the abilities outlined above. To act as a general structure to be used across different cases, a "protocol" was built up and is shown in Table 41. As the protocol shows, the first stage was to establish a good personal contact within the company. This is perhaps the first and *most crucial* stage in studying an employing organisation since, if successful, all else follows from it. The personal contact can then arrange subsequent stages. In two cases valuable personal contact was made during exploratory interviews. In the others, contact was established with the expressed purpose of visiting, observing and studying that organisation. Contact was achieved at as "high" a level as possible - in one case (a smaller company) with the managing director, in three others with Personnel Managers and in one with the head of the "IT group" of the organisation. Each contact with the organisation was summarised on a 'Contact Summary Sheet' (after Miles & Huberman, 1984, p. 50) as shown in Table 42.

In collecting data certain general principles were followed. Multiple sources of evidence were used as the protocol shows. In this way a case record or a 'case-study data base' was built up containing a large amount of different material - tapes, notes, documents, transcripts, publicity material and so on. The case descriptions shown below are, of course, heavily condensed and publicly presented versions of the total case record. In Rudduck's words, they are "the product of the field worker's reflective engagement with an individual case record." (Rudduck, 1985, p. 103).

Yin (1984) offers four conditions which should be met in making an "exemplary case study" and then presenting it:

1. It studies a significant issue
2. The study is complete
3. Sufficient evidence is displayed
4. It is engaging.

I have attempted to meet those criteria in the case reports which follow.

PART B: THE CASE STUDIES

CASE A: SMITH'S

Background Information

Location: West of England

SIC Sector: 3 (34531)

Total Number of employees worldwide: 1300 (approx.)

IT Category: Provider, and user

Year of Establishment: 1978

THE ORGANISATION

In its foyer, the company proudly displays what can only be called a modern sculpture labelled 'The Sunday Times award for the best innovation in British Microcomputing: 1986'. Although that trophy has already seen changes, it still typifies the mood, the ethos and the team spirit within the building - itself an extremely modern, though appealing structure, with a deliberate hi.-tech. image in keeping with the new industrial estate on which it is based. As I waited in reception on my second visit, a design engineer hurried past on the carpeted floor in his socks.

The feel of the foyer is congruent with the formal and informal comments of the many staff on which this case-study is largely based. The general air of motivation, achievement and esprit de corps was also present during my own observations.

Founded in 1978, at the start of 1979 the company employed only ten people - it is now recognised as "a world leader in VLSI", according to its brochure. (VLSI being Very Large Scale Integration of electronic components onto a silicon wafer or "chip"). That claim is borne out by comments in the press and in journals which will not be referenced here to preserve anonymity. The main products include a new form of microprocessor (the transputer), very fast random access memories (RAMS) for computing systems, colour graphics devices and digital signal processing products. Markets lie principally in the USA, Europe & Japan. Although the controlling shares of the company are held by a large British Electronics conglomerate, it has one site in the USA.

PERSONNEL & RECRUITMENT

From 10 employees early in 1979, the company now "employs 1500 worldwide", according to its Personnel Manager. The corporate HQ where she is based is the centre for decision-making, research and development, and design. Manufacture and testing of products takes place elsewhere in Britain and the USA, with the actual assembly of components occurring "off-shore" (an interesting euphemism) in South Korea and Taiwan.

The corporate centre had been built up almost entirely to its present level by using graduate recruitment. Approximately 20 graduates had been recruited since mid-1979 when only 20 people in all were employed in the company:

> "So we actually doubled our workforce with graduates - and quite a few of them are still here". (Personnel manager)

The fact that 1979 graduate recruits were still with the company was a matter of some pride - for a company in the semiconductor industry - the issue of why these graduates had stayed and their routes of progression in the company will be returned to later.

The predicted trend for the future would be for continued graduate recruitment, although exact numbers "had followed, and would follow, the progress of the semiconductor industry". What type of graduates would be required? Certain graduates - in electronics, electronic engineering, physics, computer science - had been sought and successfully recruited since the start. However new trends are emerging. The huge emphasis on design and development of manufactured products in the early years had been joined by a growing thrust in sales and marketing - this causes an increased emphasis on recruitment in sales and marketing. The company's evolution meant that they now needed "heavyweight semiconductor sales and marketing people". In addition there would be more emphasis on product development and application "in the field". This means in information technology, the development of software: "We've got to build up software now". Hence, the second increase in emphasis would be on graduates with expertise in software, perhaps resulting in increasing demand for computer science graduates (a point also made by the ACARD report, 1986).

Two important themes were emerging which will be examined in cross-company analysis. Firstly, and most obviously, the rapid evolution of a company such as this radically alters recruitment policies. Secondly, the importance of personnel staff in developing and shaping the future of a company such as this is huge - policies must be proactive as well as reactive. In an industry which is knowledge-intensive (Alvey, 1982), the recruitment, development, and retention of staff is vital. Staff expertise may be a company's main capital asset.

Retaining and maintaining staff

This was seen as a key issue by the second interviewee, the Training Officer and personnel manager for graduate recruitment. The importance of fully "stretching" an employee was stressed:

> "If you're going to recruit a graduate there must be enough interest in that job to stretch a graduate - otherwise you've got no chance of keeping them for longer than a year".

The company prides itself on its low graduate turnover, and the fact that (unlike many of the "hi.-tech" companies interviewed in earlier work) it did not suffer from "poaching". Were there other reasons for their success in retaining high calibre, highly marketable staff?

The flexible working environment must help. Design engineers work a flexitime 37-hour week:

> "There is no clocking in and clocking out. In the design team they may wake up in the middle of the night with the answer to their prayers. It's more difficult for the service workers, e.g. in personnel, marketing, to be so flexible."

Flexible working and self-discipline were seen as the ideal form of motivation:

> "Peer-group pressure, not the company waving a big stick, is enough to keep people working."

This could, however, cause problems at other levels:

> "It's a very adult environment which can cause difficulty for our YTS trainees".

(The role of the Youth Training Scheme in the company will be considered shortly).

Two other factors contribute to success in the retention of staff. Firstly, the company is seen as a unique organisation in the UK in terms of its products, its research orientation, its goals and its growth. This view surfaced not only in semi-formal interviews but also in informal discussion, documents and brochures, and observation. Secondly, progression through the company can be achieved without the necessity to shun technological activity and enter management:

> "... a person can achieve promotion and progress through the company on the technical side without having to take on a man-management role. He can stay in technological work, which he may enjoy most."

In many companies good technologists are dragged into the management route in order to progress - this was not seen as an attractive progression by the staff with whom I discussed the issue informally. *Generally speaking then, people with a technical* background are needed and are developed within the company. To take one example, "Field Applications Engineers" (often called systems engineers by other companies) go out to customers and help them with the company's product. They need:

- all round personal skills
- the ability to communicate
- selling skills.

These people are nurtured within the company and are quickly identified and brought on through training programmes (discussed later).

Recruitment at different levels

The PFUE scheme:

Recruitment directly from school was non-existent in this company, although it is involved in a vitally important scheme for school-leavers with A-levels who intend to go on to higher education. This is called the PFUE scheme (Pre-Formation of Undergraduate Engineers) run by Audrey Clayton of Bristol University. Her role is to link schools with companies and also provide off-the-job training. The aims of the scheme were succinctly expressed by one 18 year-old 'PFUE' whom I interviewed:

> "The idea is to give undergraduates experience of industry before they go to University, so that when they've got their degree they don't end up going into employment which is not using their skills, such as finance or management."

Thus the aim of the scheme is to help prevent the loss of people with engineering and science skills into commerce rather than industry. The company had employed 4 PFUE's in 1986 between school and (in those cases) University. Four more were employed in 1987. Each PFUE works in the company from September to July, is paid by the company, and works on his or her own project. Personnel staff felt of the participants that "they are extremely highly motivated". One participant - between A-levels in Maths, Physics and Chemistry and a degree course in Electronic Engineering at London University - feels that he is "doing something stretching to me and also useful to the company".

The scheme, in this context, looks to be a huge success. It is surely worthy of national recognition and replication in view of growing concern (now regularly expressed in the media) over the number of science and technology graduates - with expensively acquired degrees - entering finance, banking, accountancy and the City.

YTS:

Another, rather better known scheme, plays a part in the company's personnel policy. The Youth Training Scheme currently provides 4 trainees for the corporate HQ of the company from the local ITeC with which it has an excellent relationship through the Training Officer (that ITeC, coincidentally, was subject to one of the interviews described in Chapter 6). Three of those trainees were involved in clerical work, although one was progressing on the technical side. He had been given great encouragement by the training officer to acquire qualifications in computing (City and Guilds) and go on to work in Management Information Systems. Other trainees in the past had ultimately gone into Marketing, via a Marketing Diploma.

However, progress to design work was not possible:

> "The design team is exclusively specialised graduates, who have done relevant 3rd year projects." (training officer).

It seems then that, despite the flexibility of the company and the training made readily available, certain routes are not available to YTS trainees in an IT provider such as this.

PRIOR SKILL REQUIREMENTS AND SELECTION POLICIES

The prior skills required of YTS trainees were straight forward. They should be able to use:

- a keyboard
- spreadsheets
- a word processing package on a PC.

Prior requirements at graduate level were more complex and were at no time specified in terms of the language of skills. Slightly different qualities were sought for those in design and for those in manufacturing (at another site). The latter were expected to be more pragmatic, more "of this world" (personnel manager). However, common elements and criteria for both types of recruit were:

- technical strength and ability
- the third year project, and their ability to talk about it
- "how will they fit in with SMITH'S people?"

These points emerged from documents, observation, and interviews. The personnel manager reinforced the latter point:

> "People respect each other here - they seem to enjoy working with each other. We want people who can work in teams".

For this reason, collaborative projects in education (though "difficult to assess") are welcomed. Also, extra-curricular activities indicate whether "they can work in teams". Thus creativity is welcomed, but not at the expense of communication:

> "We do need people who are creative but can also communicate that creativity to other people".

The Selection Process

The company operates an interesting and very lengthy process in its primary area of recruitment i.e. new graduates. A combined effort, lasting from Friday p.m. through Saturday, is arranged to involve both technical managers and personnel staff. During that time, an informal buffet meal is arranged for about 20 candidates during which staff can assess personal qualities ("such as arrogance, enthusiasm, the ability to mix"). Staff can "disappear for short periods to write notes on candidates". On the Saturday, all candidates are asked to give a 10 minute presentation on their project, in front of 3 or 4 SMITH's engineers, then to deal with discussion on it. No one-to-one interviews are held.

This novel yet thorough selection process ties in closely with the company's ethos, working practices and (as stressed earlier) its strong emphasis on personnel management and development. The "milk round" (in which employers visit universities and polytechnics to interview students) is not used, except in recruiting for manufacturing, and even there only nine specially chosen universities are used.

A database is kept on past recruits, their universities, and their courses. Hence recruitment drives can be targetted, and there is less need for the milk round. Good relationships with Universities are also maintained through research - a database is kept of current theses and research projects. For this company, the milk round style of contact with education and recruitment is largely obsolete and irrelevant.

SKILL SHORTAGES

The notion of "skill shortages" is one which has been, and will be, questioned but it will be employed temporarily here. This company stated categorically that they do not suffer from skill shortages:

> "We aim for first or 2.1, high calibre graduates. We are quite lucky - we get an enormous number of applicants - over 1000 in 1986, without using the milk round."

For personnel staff, skill shortages were not an issue - there were no obvious gaps in the workforce:

"It's a numbers game - we can get the numbers we need".

How did they predict numbers for the future - by "wetting their fingers and putting them in the air".:

> "Companies have to look 12 months ahead in predicting numbers: Everyone is sticking their fingers in the air to predict a number. Then you do research (by looking at CSU figures) into the numbers coming out. SMITH'S get them because the work we're doing is unique, people who are that way inclined and have done their homework will apply."

Perhaps some companies were creating their own apparent skill shortages by recruiting graduates into jobs not appropriate? One personnel manager felt that this frequently occurred and could be blamed on lack of perception or expertise in personnel staff:

> "If companies looked closely at some of the jobs their graduates are doing they would find they are not graduate jobs".

This problem could be overcome:

> "If you've identified a job closely enough then you know what sort of person you're looking for".

Perhaps lack of careful identification is a cause of apparent skill shortages - an issue to be explored again later. In addition, staff would often play it safe: "if in doubt, personnel people will recruit people who are over-qualified to be safe".

This could be coupled with what I might call the three deadly sins for employers in recuitment: snobbery, stigma and ignorance:

> "If people have no experience of recruits with HND's taking jobs in the Company, then they'll go for a degree - a piece of paper which they do know."

The same will of course be true of other qualifications, with other employers, in other sectors. The issues of over-recruitment and under use of graduates will be returned to in studying other cases. It is a key factor in the problematic notion of skill shortages.

Future plans and shortages

Evolution of a company, as mentioned earlier, plays an important part in changing patterns of recruitment. This company felt that their future needs would be for Computer Science and Physics graduates, though perhaps not in Electronics. Staff were concerned with the problem of "wasted talent amongst the female population" particularly in Computer Science. The personnel manager was acutely aware of the problems of attracting women into higher education in computing, and mentioned research done in this area at the University of Warwick (see Chapter 12).

It was felt that education could do more to meet the needs of industry. Broadening rather than increased specialisation was seen as a theme for the future: "The most useful people to us are people who are broadly-based".
Industrial awareness through industrial placements of graduates ("a year in industry") was also favoured.

TRAINING: NEEDS AND PROVISION

A final, broad issue emerging in this case-study is that of training and staff development. Discussions with new and more established staff showed satisfaction with the way that new knowledge could be acquired in-house. The company tries to adapt to the needs of employees, as and when they arise, often by using one employee to train another:

> "Get the man who knows, get someone who needs that expertise, marry the two together and give them some time to work on it."

According to the "technical training officer" needs for outside training of staff were not great. Ironically the major role of training in the company was to train customers, not employees or new recruits. Prime customer contacts were trained in the use of SMITH's products.

Interestingly, an education background in certain programming languages was seen as a definite impediment in both customers and new recruits to the company:

> "I've found, in training, that customers with significant computing backgrounds have not in fact been so good at learning the new ideas of parallel processing. Someone who is more of a raw recruit, who understands computers but maybe doesn't undertand a high level programming language - if you get them young - they can learn far more easily the ways of OCCAM (a newer language) without the perversions of the other sequential languages getting in first." (Technical Training Officer)

Prior educational and training experience in computing of the wrong kind acting as a barrier to future learning is not a new concern in IT education - it was mentioned earlier in the Alvey report (Chapter 4) and will be returned to later.

CASE B: JONES

Background Information

Location: North of England

SIC Sector: 3 (31110)

Number of employees: 370 (approx.)

IT Category: User

Year of Establishment: 1868 (became a PLC in 1960)

THE ORGANISATION

The main factory backs on to a Northern industrial river, hemmed in by buildings which are either disused or in disrepair. Despite the air of surrounding decay from the riverside the company itself gives the impression of busyness and activity, enhanced by the newly renovated facade of its original building and 19th Century clock tower.

The company is engaged in producing high quality steel components for the "agricultural, aircraft, automotive, bus and truck, construction, marine and food industries" (company brochure). Gleaming examples, such as lawnmower blades, clutch plates, brake discs and disc cutters are displayed behind glass in the foyer. Although established 120 years ago, the company's markets have moved with the times and now half its products are sold overseas.

Although the reception area, with newly furbished foyer, exudes an air of formal friendliness coupled with a modern appearance the initial impression of the works themselves is rather different. Manufacturing equipment, in the original buildings, looks largely well-worn and indeed an interviewee informed me that "most of our equipment is early 20th century". Some of the older presses and milling machines dated back to the 19th century. This rather conflicts with the picture portrayed in one of the company brochures of modern machinery, some CNC (computer numerically controlled), in a clean, light environment. Indeed the working environment looks largely unclean and is extremely noisy. I was amazed at the absence of ear-muffs in most cases and practices verging on the unsafe in a few instances.

It seemed that there had been some investment *in new equipment* - at the end of 1987 three CNC machines were in use (1 lathe, 1 gear-cutting, 1 milling machine: all made in W. Germany, incidentally). However, the vast majority of plant was pre-CNC and there seemed to have been no investment in robotics whatsoever. Why was this so?

> "We haven't gone into robotics because there wouldn't be any reward. There's no point having a machine that can work 24 hours a day unless you've got 24 hours a day work for it."

> "We don't want to do a ------- exercise (a nearby company) ... spending millions on George Fisher equipment then finding out we have to sell it to some foreign company because we can't get the work. They've got 600 people out of work now because of bad management. We want to go into robotics, we want to invest in new technology but all the circumstances have got to be right ... the equation's got to balance. At the moment there's a piece missing." (Personnel & Training Manager).

This then, is some of the background to the company and its working practices - a company busily engaged in the manufacturing process with over 200 workers (largely men) on the shop floor and many more supporting employees in management, marketing and administration; a company still succeeding where others locally have failed, with an annual turnover of £6 million and a yearly profit of almost £1/2 million. What are its recruitment policies? How does it use information technology? What are the implications of its working practices, recruitment policies and use of new technology for education?

PERSONNEL AND RECRUITMENT

My impression is that the company's recruitment policies and existing personnel can best be described as traditional. The Personnel Manager, in a lengthy interview, described recent recruitment. In the the previous year, six YTS trainees had been recruited (no direct school-leavers) along with 26 "others". Where had the others come from? Some had been selected by the Job Centre, "some via ... shall we say 'my lad wants a job, my brother's out of work' and all the rest of it."

This issue - of recruitment via the grapevine or personal networks - will emerge in other case reports and its full implications will be discussed later.

The personnel manager felt obliged to use whatever means of recruitment were best for the company - his job was seen as doing "the jig-saw", fitting new people into vacancies. There was little room for mistakes:

> "We've pared down to such a level that we don't have any spare fat now ... and most industries are the same."

The Youth Training Scheme was seen as a great help in the jig-saw process: "the best thing this country's done for a long time." What function does YTS perform for the company:

> "YTS gives us what I call a 'back of the neck' interview ... you get to know somebody. With YTS you see all the shades ... you see them in all states. It is a year-long interview. Some have limited horizons - they're stokers of the ship, not captains." YTS allows him to find this out.

The selection process and the qualities sought in trainees are discussed shortly. But what about recruitment through other channels and at other levels?

Firstly, trainees from the local ITeCs (two within a two-mile radius) were not recruited. The company was not seen as an IT company; there was no awareness whatsoever of the ITeCs and their function.

Secondly, what about graduate recruitment into the company in either production/engineering, management or marketing? The personnel manager was vociferous in describing the current policy of no graduate recruitment:

> "We don't recruit graduates - the problem with graduates is that they've got no management training and they've got no hands-on experience ... they're just academically sound ... which a company like ours can't afford."

Graduates had been recruited in the past without success:

> "We've recruited graduates in the past ... but they didn't come up to expectations ... we need people with hands-on experience."

However, employees were encouraged to further their own education and training even to the extent of gaining a polytechnic degree:

> "It became a company policy to 'home-train' ... so we've taken 6 lads out of the toolroom who've gone through craft, technician, T5 (the old HNC) and funded them to get B.Sc. degrees in Engineering at the polytechnic ...because that's the only route open to us part-time."

(This statement by the personnel manager was supported by later interviewees).

A polytechnic degree was strongly favoured over a University qualification:

> "University graduates are R & D people ... they've got very good brains ... uncluttered minds. They're superb for research ... like the big companies like BP, ICI, Marconi, Ferranti, GEC can afford .. we can't. We have to do R & D on the move as it were. There isn't the fat any more for all this playing about."

The personnel manager felt of recruitment generally, as in our discussion of YTS, that the company "can't afford to make mistakes". This fear of making mistakes was a common theme in discussion and interview.

THE SELECTION PROCESS AND PRIOR SKILL REQUIREMENTS

As stated earlier, 32 recruits had been taken on in the past year. How were they selected? Attitude was seen as the key:

> "If trainees have got the right attitude, then we can succeed, we can do the rest .... but how can you train for attitude? Attitude is the key. Some schools do it far better than others ... some of the "better" schools are not as good as those with a "bad" reputation. Some of the kids from the conservative end of town think that the world owes them a living."

People who "can ask questions" but who are "willing to listen" were favoured (these qualities were also vital in the interviewer in this case!). Communication ability was seen as a useful ingredient in a recruit: "the communication we do has got to be right."

Were literacy and numeracy valued?

> "That does help considerably ... but not every job demands that ... some of the jobs we do are very repetitive."

This observation was fully supported by my own observations of the company.

Nearly all YTS trainees were eventually recruited into the company and therefore the initial recruitment and sifting process is a thorough one. That process often came down ultimately to the personnel manager's intuition: "It comes down to 'gut feeling' ... you either like them or you don't."(see Jenkins, R. (1986), page 52) He also sought "triers". "They've got to show that they've tried at school."

But the crucial question for this organisation as with so many others in both the case and the interview studies was:

"Will they fit into the company?"

Presumably, this can only be judged by gut feeling.

Prior Skill Requirements

How valuable were prior skills in selecting new recruits? What specific skills were needed, particularly in IT? The response here, as with so many others, made no mention of specific prior skill requirements. Of recruits who would be using computers, the personnel manager would ask "if they like computers":

"If they like computers then I've got a winner."

My observations of working practices in the company showed that recruits into IT jobs would be using computers in administration, not the production process. Why were prior skills not insisted upon in this area?:

> "It would be an advantage if they said to me 'I've been on a word-processor' ... but we pay for them to go to college and get qualifications once they're here."

There was a clear distinction between education and training in this context:

> "The school's job is to build people up for society ... which is education. My job is to train, to be specific."

This led to an unexpected digression on the education system and its output:

> "Youngsters are demoralised in their last year at school ... they come to me and have to be switched back on again. It helps considerably if they can come to me and say 'I've got five O-levels', but they've gotta be O-levels in what I want ... I don't want history and sociology."

Other views on the education and training systems, which have serious implications for the way in which those "systems" present themselves, are considered later.

THE USE OF INFORMATION TECHNOLOGY IN THE COMPANY

The distinction was made earlier between "IT providers" (giving either a product or a service in IT) and "IT users", who actually use IT services and products in their industry. The company in this case, as an IT user, raised some particularly interesting issues which will be dealt with in detail. The account which follows bears heavily on a long discussion/interview with the young (late twenties) computer manager who gave his views and perspectives freely and at times bitterly.

The development of IT use

A computer system costing over £100,000 had been purchased by the company two and a half years previously. Prior to that there had been one small computer (an Apple) in the whole organisation, used in the Accounting Department. Fifteen staff had been sent, in 1983, to a local college of FE to take a basic course because they had "a vague interest in computers", though no previous knowledge. The company paid the fees - the employees gave their time, 30 hours over 10 evenings. Two employees took and passed the City & Guilds exam. (A.T. and P.B.), and went on to a subsequent course on the language PASCAL:

"Then suddenly we got this computer system." P.B. took a degree with some computing at the nearby Polytechnic and took over the system. After 12 months he left, having been "poached" by a computer firm at the other side of the city.

"There was nobody left to fill that gap". (in April 1986)

P.B.'s degree was paid for by JONES, in their time, and then he had left the company after 12 months. This had happened to the company before, according to A.T. Clearly, there was no intention to let A.T. follow that path. He was left to run the new system, costing over £100K plus supporting software from 3 software houses, his only formal training being a 10 week course in an FE college.

Applying the computer system

A.T. is now the computer manager. His job is to manage the use of computers which occurs in these areas of the company's work:

- stock control (of raw materials)
- production control (work in progress; capacity planning; database of products)
- payroll
- shop floor use.

There was no use of computers in process control and manufacturing itself, except for the 3 CNC machines mentioned earlier.

How efficient was the computer system in helping the administration and running of the company? Somewhat cumbersome and ill-planned, it seems:

> "We originally specified our computer system to fit in exactly with our old manual system, which in my opinion is totally wrong - it was an ideal opportunity to streamline the old system and cut down its complexity. But we didn't - we took the manual system and converted it exactly across to a computer system ... and it causes unknown problems. Everything we've got on the computer now is an exact copy of the old manual system."

The computer manager was rather bitter, even resentful, of the way in which the system had been designed and implemented. He was not involved in any strategic planning - he was in "works", management were in "management":

> "I don't get involved in any of the meetings on what happens next, which is really bad in my opinion. I just get told what's been decided and I have to do it... my boss and all his associates don't fully understand how the computer system works."

Managers, at a level above his in the hierarchy, were making expensive decisions from a basis of ignorance of IT:

> "They're making decisions and they're not quite sure what they're talking about."

These comments (whether fully accurate or not) certainly have implications for the company and its structures, but more importantly for this document they have profound implications for the future education system, not just in its treatment of technology.

Staff involved in using IT

> "To make the system work, it's so complex we need people to do it."

Although there is no use of IT at all in estimating and sales (an "area for development"), between 50 and 60 staff (out of 80-90 administrative staff in all) were involved in using computers. There were no other programmers or systems managers in the company except A.T. No other staff (it seemed) had received any IT training - the computer manager fought to fill this training gap:

> "A lot of my time is taken up by people saying 'help me, I'm stuck', or 'It's done this and I don't know why'. I'm firefighting all the time."
>
> Would there be new recruits into computing/IT?
>
> "I just can't see it happening. The new Managing Director is likely to shed administrative staff. 90 admin:280 on the shop floor is seen as a high ratio ... but our admin. systems are so complex." (as explained earlier.)

FUTURE DEVELOPMENTS FOR IT IN THE COMPANY

A.T. felt that great scope existed for extending the use of IT throughout the company:

"Even the system we've got now, we're not using". Areas ready for development were production control and capacity planning - these were "not fully exploited", indeed sometimes "totally ignored".

One area for profitable future development is shop floor data collection. This involves, essentially, collecting and storing detailed information on the jobs which workers on the floor were doing and had done. At present, all details are entered by hand onto job cards, checked by the works supervisors, then keyed in by a clerk in the office. In a new system bar-coded job cards for each employee would be "wiped through" a unit on the wall and log-on buttons pressed which log a person on to that job. This would save 3 jobs of people keying in data.

Its great advantage in planning and control would be that "the data would be so fresh and new". But would shop-floor workers accept it? A major difficulty would be acceptance by staff, particularly older workers and members of our "coloured brethren" (his words) with limited English. A fear of computers and a reluctance to use them was seen as a large obstacle.

Herein lie important messages for education, not just in IT.

But the key problem for the computer manager in developing IT and exploiting it fully lay firmly in the management structures "above" him.

A.T. was not tied in with the management structure making strategic decisions - no contact at all:

"It's just the way that JONES are".

Senior managers were more to blame than any worker on the shop floor for the lack of exploitation and development of IT for the company's benefit:

> "I've got hardly any contact at all with the management above me so I don't think they know how much we're not using the computer. It cost a fortune to buy, but nobody has ever questioned what the utilisation is. Is it worth it?"

SKILL SHORTAGES

This was not a large issue for the company. The personnel manager felt that there was a shortage of skilled machine operators - especially "skilled press operators, genuinely skilled" - but there was no other evidence to reinforce this comment. He predicted growth for the company, to around 50 employees in 18 months time. This might create a 'skill-gap' in management; and a consequent training need:

> "It's going to put a lot of pressure on the company ... because the managers have to be trained to accommodate this ... their thinking has to be different now ... we need more management training. Managers aren't born, they're made."

Currently there was an ad. in the local press for a new general manager, but would they "get the right man" (note gender) even by offering "a good salary and a car?"

VIEWS EXPRESSED ON EDUCATION AND TRAINING

The training manager was a great supporter of YTS ("the best thing this country's done") but almost repetitive in his condemnation of higher education, particularly in the University sector. For example:

> "I think universities have got the best untapped brains in Britain ... but they're not being guided to the basic problems ... they're being guided to hypothetical problems."

He felt that the University was unapproachable, although he had excellent links with the Polytechnic in using "their up-to-date equipment to help us step forward" (e.g. electron microscopes, CAD/CAM developments):

"....they respond superbly - we just need the courage to ask". As for the other sector of HE:

> "I wouldn't ask the University because they don't talk my language ... I feel that they're 2 or 3 steps ahead. We both speak English but we don't communicate ... so we don't do any business."

The personnel manager felt that the education system must pay more attention to engineering in order to support manufacturing industry:

"We've got to build a manufacturing base and we've got to use the education system to support us. We've got to start developing courage again". (as a nation).

Engineers lack status - schools should "profile" them in their curriculum, produce "profile awareness":

"We're still fighting 150 years of 'going in the army' or 'going in the Church'. The country can't afford to continue on that path. With an engineering degree, every job in the world is theirs (the graduate's) ... every one".

Except, it seems, at this particular company.

In-house training

Perceptions of in-house training differed between at least two informants. The training manager claimed that 2½ of annual turnover was spent on training, compared with a quoted figure of ½ as the national average. He felt that training was vital for the future:

"Getting the youngsters right now is my pension guaranteed 20 years from now ... so I've got to train right now."

Confidence building and awareness were seen as two main aims:

"As a trainer I don't sell education ... I sell confidence, because if you've got confidence you'll do things."

"We're interested in being kept up to date, being kept aware." (robotics and computer systems were mentioned in this context.)

In sharp contrast, the computer manager (A.T.) felt a need for training which had not been fulfilled:

"Apart from that 10 week basic course I'm totally self-taught. I'd like courses on programming techniques or software technology."

The main barrier was in obtaining release for his own training and development:

"I'm the only one involved in computing so that is the main problem." He would have to give up his own time unless, "I really put my foot down upstairs and started shouting a bit". He was already considering leaving the company to follow his short-lived predecessor, who had been so well supported by the company in his own development. Herein lies the tension in training.

CASE C: BROWN'S COMPUTER GROUP

BACKGROUND INFORMATION

Location: North Midlands

SIC Sector: 8 (83940)

Number of employees: 95 to 100 (as of end 1987)

IT Category: Provider and user

Year of Establishment: 1979

THE ORGANISATION

> "Long established in prestigious catering circles, Brown's has now risen to become a market leader in the design and supply of specialised computing systems." (reprinted from a magazine article)

This computer group originated from within a catering company, established in 1934, and began by developing its own system for managing and controlling catering activities. That computerised system is now sold nationally to a variety of catering installations and many hospitals. The group now puts its energy into 3 main systems: the College Management System (CMS) for Further Education Colleges from 1981; the Business Management System for stock control, accounting and order processing from 1982; and the Catering Management Information System from 1983. A Schools Administration system is planned to follow the huge success of the F.E. college system now used by half of Britain's local education authorities.

The computer group's success has led to rapid changes in the numbers employed, the nature of the company and its accommodation:

> "Eleven years ago the seeds of the company began to grow with a small budget and three employees. By 1985 an annual turnover in excess of £1 million had been achieved. The three sister companies which by now had emerged, covering the three aspects of programming, hardware and systems, joined forces to become The Fretwell-Downing Computer Group. The fifty strong company went on to capitalise on success and the following year saw them outstrip their parent catering company for the first time.

By 1986 the time had come to move from the original, and by now very cramped quarters, into a more spacious modern tower block. Success is such that comfort is short-lived, however, and already elbows are rubbing again. By 1987 annual turnover was climbing to £3 million and staff levels to one hundred." (reprinted from magazine article, as above)

I visited the spacious modern tower block with its thick, plush carpets and its exponentially growing number of employees. My observations confirmed my expectations of a fast-moving, "hi-tech." organisation - the welcome was warm, the initial image excellent. A lot of work and money must have been expended on that impression and the group's image.

My key contacts in the company were the managing director (whom I had met previously when a welcoming offer was made) and the Personnel Manager. I was also able to talk informally at length to a Youth Trainee and to the Training Officer. The picture painted below is based on discussions and interviews with those contacts; on my own observations; and on published material.

PERSONNEL AND RECRUITMENT PRACTICES

Growth

The growth in employees in the company is shown by the dramatic sketch graph in figure 12. Despite this growth, the company had "no policy as such" for recruitment - it was a case of "every manager for himself". The Personnel Manager traced the group's growth:

> "Six or seven years ago the company started with half a dozen people. Recruitment was mainly through "an old boys network" through the founder's contacts at Cambridge: "I'm trying to start this off - come along and give it a go". Perhaps 60% of this company have joined by invitation."

The personnel manager himself was one of those invited.

Specialist divisions had grown up in the group, such as R & D, customer support, marketing and so on. Figure 13 shows the breakdown given by the managing director. The largest growth has been in product development and customer support.

Selection Policies

The importance of personal networks, contacts and invitation in recruitment has already been noted. In selecting recruits the ethos and feel of the company was also a prime consideration.

The company has a family feel to it. When interviewing for new posts it is very much a case of: "are they a Brown's person?" and their actual qualifications come second - though not a poor second."

I sensed the family feel as strongly as the personnel manager did. The issues raised by such policies and practices, implicit and explicit, are raised generally later.

Interviews are used extensively in selection, which is done "very much by intuition at present". A manager is always brought in to the interview, sometimes the managing director himself, if only for a hello and a handshake. No aptitude test is given at present, although the personnel manager was considering bringing in "an expert system both for selection and training". The system, he claimed, (called EXPERSIS) would offer 30 man-years of personnel-experience for £10,000. Not a bad bargain, he felt!

Current Recruitment

Currently 3-4 programmer/analysts were sought depending on the development of the existing College Management System: "They will form the nucleus of a new team".

Graduates, preferably with 3 years experience, were sought. Would they be able to attract them?:

> We are paying good, marginally above average rates for this area - a salary of £9,000 here is the equivalent of considerably more in the Home Counties".

In addition the company offered temporary housing accommodation as an extra attraction to get the right people.

Unfortunately, I was not given the opportunity to interview any such new graduates to see how they felt about their salaries, perks and prospects.

Five other jobs had been advertised recently in the local paper, for posts such as Receptionist, Accountant, Customer Support and Accountant. This was all part of the rapid growth from "60 to 100 in 12 months".

Retaining staff

Alongside its rapid growth in personnel, the company (it seemed) was also successful in retaining staff:

> "Only 5 people have left this company since it was formed, and one of those was a YTS trainee. Every other YTS trainee has been taken on."

The personnel manager felt the company's flexibility and responsiveness should take credit for this:

> "Once recruited, people can move to other jobs if they show aptitude. The company is very dynamic in that sense - perhaps organic is a better word. It is a very responsive organisation."

Plans for the future

In order to develop, it was felt that outside experience in IT would greatly benefit the company. In the company's growth, many graduates had come fresh from polytechnic or university and been given experience:

> "We have a relatively immature workforce in terms of programmers and analysts - they have no real-world experience, we are giving them that experience".

Future development, they felt, would be enhanced by outside IT expertise and experience:

> "In order to advance more quickly we really need to bring in people who have experience other than Brown's experience. We are by no means perfect in terms of programming and analysis."

One possibility favoured, though not practiced, would be "exchange of staff between companies".

Despite its rapid growth, the common feeling was that "there is considerable room" for further expansion of the company.

LEVELS OF RECRUITMENT

The backgrounds of the key figures in the company (its directors and managers) were described as a "real mixture" - a doctorate in Chemistry, a Theology degree, a degree in Business Studies, plus those directors who had moved from Catering into Computer Systems bringing with them their own traditions and working practices.

Graduate Recruitment

Most raw graduate recruits have been in Computer Science, though there is no rule to this effect. A wider range of degrees is acceptable: "a degreeshows that one is capable of a certain level of thought". However, there are limits:

> "It's unlikely that we would employ a Classics graduate as a programmer".

Raw graduate recruits were offered starting salaries (in 1987) of £6.5 to £7 thousand. The personnel manager realised that this was well below the national average for an IT employer but relied on the firm's location (in the North and in a pleasant environment), along with help in accommodation and other services, to attract staff. Graduates with experience in other companies were, of course, offered salaries in the region of £9 to £16 thousand p.a.

Recruitment below graduate level

The company does not recruit school-leavers, though it has always been involved with the Youth Training Scheme. Most trainees in the past had "almost always been recruited". At the time of the study, eight trainees were in the group: 2 in production; 3 in software support; 1 in hardware support; 2 in secretarial work (both female).

All trainees are carefully selected, using two interviews but no aptitude test. Once again "if they're a Brown's person they join". The YTS was seen very positively:

> "They are not cheap labour - we don't want cheap labour, we haven't got room for it."

This view was strongly felt and supported by my own observations - there was no function for "cheap labour" in a group such as this. Low-level, unwanted labour would simply be a drain on the time of other staff.

TRAINING AND THE NEEDS OF THE COMPANY

One of the key issues to emerge from this study was the great dilemma facing a rapidly growing company such as this when it comes to training. Staff are overworked, no-one has free space and time, yet the group needs to develop and grow.

Training for customers/training for staff

It soon became clear that the company was engaged in two types of training which needed to be kept separate in discussion (but are often confused in other contexts). Customers and users of a company's IT products need training - on the other hand, staff within the company need training. The former, training for users, is provided by a specially appointed trainer in the company. She "trains the users" and actually sells training as a commodity to customers. This takes place at a beautifully situated country mansion in parkland setting. In contrast, training for staff is rather more contentious.

Staff development and training

All staff are given an induction course: a basic awareness of computers plus a more detailed knowledge of the company's products (the Management software mentioned above). Subsequently, training for staff is more difficult for two reasons. Firstly, "training needs vary so quickly". Secondly, and more importantly,:

> "The main problem is freeing-up staff to go on courses, even for half-a day. We haven't got staff sitting around waiting for things to do - taking someone, even for half a day a week, means a 10% reduction in their productivity."

To the management staff these two factors pointed clearly to the need for carefully planned, in-house training over which they have total control.

In-house and Out-house training

It was felt that outside training courses, provided perhaps by a University or a Polytechnic with (say) MSC funding, could not possibly be "directly relevant" and might even be slightly risky:

> "We must have training that is directly relevant to our requirements."

How could an outside body provide this?

> "Our requirements are a little bit different, or perhaps totally different, from a company three doors up the road. Our specification of needs will be highly specific to the company - I want you to teach Joe Bloggs how to log on to the Gandalf network, give him background information on the Gandalf, why we've got the Gandalf and why we bought it".

To use training outside would also be to take a risk:

> "If employees go away and get training which is not directly relevant and come back here and try and do it ... then we've blown it."

These factors in a company such as this,all pointed to the need for in-house training where "we have total control over what they are being taught - training must be absolutely relevant to our situation".

Outside short courses for staff, provided say by a University are seen as "good, background information but that's exactly what it is. We have enough to do just keeping the company going."

Courses outside working hours were seen as most acceptable to the company - but from a personal angle, "how can a person grapple with new ideas after a day's work?"

These dilemmas and tensions in training, comparable with those in CASE B, were a major concern of the Personnel Manager.

GENERAL OBSERVATIONS

The above case report has outlined some of the key issues emerging from the study of a small but rapidly growing computer group which prided itself on customer support and service:

> "The company is much more than a software house - it grew from catering and ... we have carried our ethos through from the service industry."

My impression was of a highly successful company with a deliberately friendly, yet high-tech. image, with a strong family feel to it. The Youth trainee who showed me the open plan working environment, with networked personal workstations on each desk, clearly felt a part of the company although he was still officially a trainee. He had been given a role and a responsibility.

This is an IT company which has not suffered in the past from skill shortages but which faces tensions and dilemmas over its training for the future.

CASE D: BLACK'S PLC

BACKGROUND INFORMATION

Location: North of England

SIC Sector: 4 (42141, 42142)

Total number of employees worldwide: 32,000 (approx.)

IT Category: User

Year of Establishment: 1725, original foundation. 1982, became a PLC.

THE ORGANISATION

Black's is an international food group, manufacturing and retailing confectionery, snack foods and grocery products. It is British based with its central headquarters in Northern England, the site which I visited. Worldwide, the group comprises 25 companies operating some thirty factories and 800 retail outlets. The picture which I was able to gain of the company is therefore based on a very central perspective.

Group headquarters were keen to welcome me and arranged a large number of interviews, informal discussions and observations on which the case report below is based. I focussed particularly on the use of information technology in the company and its implications for education, since I could not possibly hope to obtain an overall picture of an organisation with an annual turnover approaching £1.5 billion.

The management structure of the company is based on "Groups" such as "Group Engineering", "Group Personnel", "Group Products", "Group Finance", "Group IT" and so on. I spoke to employees from different groups but spent most time with those from "Group IT" including its head.

Before discussing particular issues it is worth noting two general trends in the organisation, commented on by several employees. Firstly, there would be increasing moves to more retailing to complement the existing dominant activity of manufacturing. Secondly, the company was becoming increasingly international in its outlook and in increasing its markets.

PERSONNEL AND RECRUITMENT

Recruitment into the company takes place at several levels. I was able to discuss aspects of recruitment, past and future, with a number of employees.

Graduate Recruitment

In 1987, 45 graduates had been recruited to the central site (c.f. 70 graduate recruits in 1986, a peak). Some went into technical jobs, others were taken on as "potential senior managers", where degree subject is not so relevant. One manager interviewed in particular felt that there had been a strong tendency to over-recruit graduates:

> "I think there's been a tendency to recruit graduates into jobs which are not suited to graduate recruitment. I think it's important that unless you give graduates good work to do once they start with you then they'll clear off and work for somebody else." (Management Development Manager)

This interviewee's role was to develop graduates as potential managers - as a new recruit himself he felt that this had been badly handled in the past:

> "We need to expect more of our graduates than we have been doing to date. You're not an experienced practitioner at age 22, but you have an intellect. Companies do treat graduates like kids. Graduates want to make a contribution ... they don't want to be light in terms of either quantity or quality ... there's a terrible tendency not to use graduates sufficiently."

He felt that this had even resulted in the loss of good staff:

> "It's my view that very few people leave an organisation because they have too much to do - but very many leave because they have too little."

Was the company a victim of 'poaching'? He felt, in response, that an organisation from which valuable staff had been poached had only itself to blame:

> "The more able guy is not going to sit around doing routine work."

This manager, as the comments above indicate, clearly felt that the under-use or under-exploitation of graduates was a vital issue for this organisation and others:

> "Companies have got to get their act together in terms of using graduates."

School Leaver Recruitment

The views expressed above had important implications for recruitment at other levels - in that year 20 school-leavers had been recruited nationally:

> "We recognise the fact that we don't want to recruit graduates into jobs for which they're over-qualified. We've been recruiting locally for the first time for a number of years ... at a super 'O'/'A'-level grade. We are looking for people who are going to be backbone members of departments rather than tomorrow's superstars."

These people would take up further education, through distance learning for example.

Youth Training Scheme recruitment

The organisation has a strong involvement in the YTS but mainly for training staff on the clerical side:

> "We would use that (YTS) as a training ground for clerical staff or staff at a junior level."

One hundred Youth Trainees were involved with the company in the UK. However, there was little or no recruitment of staff from YTS into information technology jobs as such:

> "We wouldn't take many YTS people into the IT side."

The company did claim to have "links with" the local ITeC, although these were difficult to identify and I was unable to pursue this.

Personnel Trends and developments

I discussed personnel trends both with the Management Development Manager and the Personnel Manager. The former, the new recruit, felt that the company was "not lean, mean and keen" - it was slow-moving, overstaffed and run on very different lines to the USA (which he seemed to uphold as some sort of role model). He felt that one of his jobs was to make the headquarters more mean, lean and keen, partly by "retiring people earlier" but also by changes in person-management.

However, graduate recruitment would remain steady:

> "We should not, at any price, fall off in terms of graduate recruitment ... because we really do need to build our talent banks up, rather than allow them to fall down."

Once again, the need to retain them, and train them, was stressed:

> "We're losing them because we're not developing them properly".

It was felt essential to train graduates more fully for management by providing the "two necessary conditions for training: motivation and feedback". These would be provided in future training courses, which would also give certification and accreditation leading (for example) to a 'Certificate in Financial Competence'.

The personnel manager also felt that the company would become leaner with a gradual reduction in the total number of employees. There had been a twenty year pattern of fewer "process workers" recruited which would continue. He felt that we "are moving into the age of the certificate" (still?; Dore, 1976) and welcomed the National Council for Vocational Qualifications (NCVQ). This personnel manager, as did so many others, felt that "the future lay in learning personal and social skills".

SKILL SHORTAGES AND RECRUITMENT TRENDS

The personnel manager of the corporate HQ felt that there were "no major skill shortages in the alliance" - if there were difficulties he felt that there might be "problems with recruiting graduates". In contrast, one manager felt that, already, "there aren't enough graduates to go round". He felt that "selling the company" was vitally important - a video had been produced recently to supplement

Milk Round presentations, and the 'Graduate Recruitment Brochure' was being improved. He was seeking a "state of art" graduate selection process to compete with those companies with a better image (see perhaps Case A) who had no difficulty in attracting graduates of a high calibre. People's perceptions of the company as a "chocolate factory" did not help.

On the IT side of the company, graduate programmers were sought but those with the "right" degrees could not always be recruited:

> "We look for a relevant degree where possible ... but it's not always possible to do what we want to do."

As a result the company was considering "looking at recruiting non-graduates as programmers."

At the time of the study, it was felt that the only serious staff shortages were at higher levels, and this was partly the fault of the company itself:

> "We're suffering at the moment because we haven't got enough good people around to fill positions ... one reason for that is that we genuinely don't have enough people of the right order, and the second factor is that we've not developed them sufficiently, not moved them quickly enough to give them the right experience. We have to learn to manage that a bit more." (Management Development Manager)

INFORMATION TECHNOLOGY STRATEGY IN THE ORGANISATION

The use of IT in Black's is directed centrally by a team known as 'Group IT'. I spoke at length to the Head of the group and later to two of its newly-recruited graduates.

IT is used widely in all aspects of the organisation's work and had developed beyond recognition since Black's obtained their first computer, an IBM, at a cost of £250,000 in 1961. The role of 'Group IT' is to develop the world wide use of information technology by being both "supportive and reactive". The twenty key employees in the group were divided into 'Research' and 'Consultancy', the latter being responsible for development strategies with a role both "influential and advisory", but not "dogmatic". (Head of Group IT). This wing of the group was pushing broad strategies, such as Computer Integrated Manufacturing (CIM) and new approaches to retailing (an increasing concern).

From my interpretation, the role of Group IT can be divided into three concrete areas, labelled direction, content and context:

1. Direction - advice to the company Board on IT directions.
2. Content - advice on technical content of major proposals and investments in IT e.g. purchase of a new mainframe.
3. Context - development of a broad idea of what's happening around the world, by setting up their "own grapevine", thus providing a context for assessing any new developments in IT.

To the latter end, communications systems were being developed between different parts of the company around the world. The strategy is to establish DISSOS (Distributed Office Support System) nodes at points worldwide e.g. South Africa, Australia, Japan and the USA. With associated hardware the "general policy is to use IBM or DEC machines" although this is not always possible.

Black's had therefore established general policies and strategies towards the development of IT through its team of 20 in Group IT. The Group is in close contact with the Board of Directors (on the same site) who are felt to be "generally supportive". This structure for enhancing the use of IT appeared to be effective and flexible - in sharp contrast to the manufacturer described in CASE B.

The members of Group IT seemed to be largely graduates (although no figures were available). Two members, both of whom had been in the company for 3 years, were chosen for me by the Head of the Group. In informal interview and discussion their perceptions of the company were revealing.

A.C. has a Computing/Economics degree; S.J. has a first degree in Zoology with a Ph.D. involving computing. Both were smartly, conventionally dressed (suit and tie). Both had mixed feelings about their role in IT and more generally their future in the company itself. S.J. was worried about his "underuse" in terms of both quality and quantity. His job specification, in the research area, was "vague". A.C. was worried about his job prospects and future in the company: "Black's is not an above average payer". Both felt that they are highly marketable as semi-experienced IT staff - both felt that they could move to a better paid job. Both were mobile - they felt they could move to any part of the country to take an IT post, although both liked the Northern city and its facilities which they lived and worked in. Both IT workers felt that the career structure at Black's was "holding them back" - it was far too "paternalistic". Yet, though both were critical of the company's career structure and paternalism, both exhibited a certain warmth towards it and some of the impressive services and facilities it offered. In addition, both felt that they had received adequate training in terms of short courses e.g. on C, UNIX etc.

GENERAL OBSERVATIONS

My own perception of the organisation was of a caring, in some ways conservative company, with an ethos which still retained some of the qualities and services probably present in the 18th century (including its own attractive library for employees). Structures and hierarchies were clearly defined within the company, it seemed, with the separate canteens on different floors for different staff a clear indicator of well-established divisions.

It seemed unlikely to attract the kind of high-flyers in information technology which company-A was capable of recruiting - it also appeared less likely to retain such people. However, from the various interviews and discussions there appeared to be few, if any "skill shortages" in the company. The largely graduate workforce in Group IT were given enough scope, flexibility and up-dating to appease some of their concerns although they have far less autonomy than the design engineers in CASE-A. The two graduates I conversed with, for example, were required to "log-on" and "log-off" using a personal bar-coded card and machine reader as they entered and left their department. Their office structure, however, was open-plan, fully networked, with terminals at every desk.

My general impression was of a successful, friendly organisation with a keen eye for a leaner and meaner future. Issues and trends, such as "healthy eating", "foreign competition", "pressure from large retailers", and increased multi-nationalism were being responded to. Recruitment is occurring at all levels, including school-leavers, although those responsible for developing and enhancing IT in the company are almost exclusively graduates.

Perhaps the key point emerging for non-graduate recruitment is the suggestion (from Management Development and Personnel) that as manufacturing staff (process workers) are shed, more and more of the workforce would move into the service sector. An expanding example is the "Customer Relations Office" which is now handling over 1000 calls each day. This contrasts with the new unmanned warehouse for a famous chocolate product which I was not permitted to visit.

Many more workers than perhaps is realised, although officially employed in manufacturing industry, are actually engaged in service jobs. This is likely to be the case increasingly in the future (Gershuny & Miles, 1983; Gershuny, 1978).

CASE E: WHITE'S ELECTRONICS LTD.

BACKGROUND INFORMATION

Location: East of England

SIC Sector: 3 (3440, 3451, 345420

Number of employees: 650 (at December 1987)

IT Category: Provider and user

Year of Establishment: 1938

THE ORGANISATION

The attractive company brochure describes the organisation as a "unique" one, capable of "providing a total resource in semiconductor based multiple device components" i.e. it manufactures chips. The company researches, designs, develops and manufactures "state-of-the-art" integrated circuits (Chips) which are sold to a range of markets. Though founded in 1938, the two factories I visited in Eastern England were opened in 1981 and 1986.

Cleanliness and modernity abound. There is 'No Smoking' throughout; open-plan working is the norm; buildings are clean, modern and thickly carpeted; dress is semi-casual (not as formal as Case D, not as overtly casual as Case A). Workers at all levels mix socially in the canteen - group work is common, especially in design. Activity is clearly separated (as in Case A) between Design and Manufacture with consequent clear divisions of labour and educational background which are discussed later.

Production of integrated circuits in the company is also separated into two "Business Units", one of which is aimed at the

Space and Defence market, the other at the Telecommunications and Industrial Side. The former provides high reliability chips, often radiation hardened for use in (say) satellites, which are not mass produced. The other Business Unit produces lower reliability, lower cost chips which are mass produced for organisations such as British Telecom. These divisions are of some relevance in determining the activities of the company and recruitment for them. Both business units receive central support e.g. in clerical or marketing work - both employ "professional staff" and "operatives" in roughly a 50:50 ratio.

The case report of the organisation which follows is based on a range of interviews and discussion, together with extensive observation. In addition, published documents were freely provided.

LEVELS OF RECRUITMENT

The YTS Intake

White's started with a 40 place scheme, but now have a 60 place scheme which is undersubscribed - 48 are actually "on-board". Plans are afoot to increase to an 80 place scheme involving both the clerical and technical side of the activities.

Apprentices?

The personnel manager interviewed described 15 of the Youth Trainees as "apprentices", but the YTS Managing Agent based in the company refused to use this label:

> "Our 'trainee technician engineers' are yesterday's apprentices - we don't use the word any more, it's a mis-nomer. They're not apprentices because they don't get indentures ... but we always call them 'apprentices'."

A large number of candidates apply to become trainee engineers (apprentices), so initial selection is made by insisting on 4 O-levels or its future equivalent (concern was expressed that standards are falling with the advent of GCSE - "we could put people into the college of technology and they will fail" (on BTEC courses)).

Selection for Youth Training virtually takes the form of streaming - an aptitude test with informal interviews is given which puts them into "certain boxes: probables/possibles/not quite making it." (managing agent). Then the organisation "Takes people into YTS who didn't make the grade for Trainee Technician Engineer". Becoming a Technician Engineer involves extensive further education: trainees spend 36 weeks off-the-job at a local college on an integrated course embracing T2, ONC, plus general engineering and specific electronics applications. Then in the factory they are dedicated to one of 3 Divisions for a further 3 years. "After 5 years all apprentices should obtain a qualification of Higher TEC" (the Higher National Certificate).

The company is clearly active in Youth Training and its use of YTS is covered in detail in a later section.

Sponsored students

The company also actively seeks students to sponsor in higher education:

> "A-level leavers, 3 B's if possible. Going on to Electronic Engineering and possibly Physics ... but predominantly we're now going for Electronic Engineers: Physicists take too long to train up."

Six or Seven students are taken. 12 months are spent in industry: 3 months in each Division at H.Q. and 3 months on a "practical engineering application".

Then, sponsored students go on to University (in this case) with some vacation training. Their contract says "they will join us for 18 months thereafter". Most stay longer than 18 months.

Graduate Recruitment

The company regularly recruits 30 graduates p.a., mostly Electronic Engineers, some physicists. It has its favoured universities, notably Queen's (Belfast) and Manchester. Recruitment of high-calibre graduates is not always easy: "The milk round is a disaster this year" (1987). However, the Autumn Fairs are seen as a "bit dodgy", especially as graduates need security clearance. According to the personnel manager, "graduates are getting choosy. ..... is not seen as a favourable location: a lot of graduates go for the big cities. Most people don't know where ..... is".

As a result, in practice entrance requirements are de facto reduced: "We place a lot of emphasis on interview. Our offer depends on their getting a 2.1 or a 2.2, but if they come down to a third we'll probably knock £300 off but still take them" (starting salaries at that time, 1987, were in the region of £8500).

In summary then, the organisation appears to have little trouble in attracting the raw recruits it needs. Unlike some companies at the forefront of IT industry, recruits at a range of levels are involved, though the design workforce is virtually all-graduate. Those interviewed did not feel that the company was high up the "pecking order" in attracting high-calibre graduates, partly because of its location.

PRIOR SKILL REQUIREMENTS AND SELECTION CRITERIA

Q: "What do you look for at interview?"

A: "A good handshake. A weak handshake is a bit disconcerting."

Graduate Selection

The YTS and selection for it is looked at shortly - at graduate level the ideal candidate is seen as:

- technically competent
- able to communicate
- with "a bit of sparkle".

A lot of technical questions are asked at interview but communication is seen as vital, both as an ability in itself and as a prerequisite for any judgement by personnel staff:

> "It's very difficult to judge if they won't communicate."

On a personal level, recruits were sought who were "bright-eyed and bushy-tailed" but more importantly able to fit into the organisation:

> "We don't want somebody who's going to be isolated or alienated."

This was bound up with technical considerations - although technical competence is sought there was (as in other Cases) a fear of the whizz-kid:

> "We perhaps don't get as many innovators as we'd like . . . there's always a fear at some levels that they could become a threat. You know . . . 'he's too good for us'..."

A relatively inexpensive selection package called "Comparator," which runs on a variety of microcomputers is being used in providing a "personality profile" of staff and potential recruits. The package asks a large number of questions about the user's interests, inclinations and attitudes and forms a profile of the person on the basis of responses. Staff expressed some faith in the validity of the program though after using it my feeling was slightly more sceptical.

ISSUES IN RECRUITMENT AND STAFF DEVELOPMENT

Use of Graduates

The organisation, in common with other Cases, is actively exploring its use of graduates in relation to other levels of entrant such as technicians. On this issue I spoke at length to the Business Manager of the Integrated Circuit (IC) Division and the Personnel Manager.The former was convinced that "some engineering graduate vacancies will be replaced by technician recruitment in future." He felt that graduates should take engineering decisions and not do jobs that technicians can do e.g. data collection, data preparation, loading programs. The "quality of work" of the graduates should then go up. "Apprentices" (technical training engineers) should provide "technical groundcover" - Technicians would come in at "the bottom of the engineering tree." Another important factor in changing the differing roles of the workforce is that new design technology will permit the engineers to take on a different role, a higher status role.

A slightly different view was taken by the personnel manager over the division of labour between "graduates" and "technicians" and its consequences for recruitment:

> "We're introducing ex-apprentices into the Design Centre - we should be giving graduates more support. But there is a tendency to say 'One technician for every graduate', and we'll almost double the numbers in that technical area . . . on the other hand, the danger is that you'll turn off the graduate if you don't give him the support . . . if you give him a repetitive job. If he's doing 'standard product' and he wants 'semiconductors custom', then he won't want to sit at the Mentor and just plug in 'standard cells' - he'll want to do some innovative work . . . and let the technician do the bread-and-butter stuff."

(As these interview excerpts show, the tendency to use the term 'apprentice' is still strong, despite the insistence of the YTS Managing Agent.)

These discussions obviously have important general implications for the division of roles within a new technology company, the effect on those roles of the technology itself, patterns of recruitment, and the retention of high-calibre staff.

A second concern of the business manager was that although designers had once had a "very commercial view" of their work e.g. in designing chips, more recently they seem to be working in "a glass box". This worry of the Business Manager may have implications for recruitment and training in future e.g. leading to the recruitment of graduates (Electronic Engineers) with a more commercial view of integrated circuit design.

Staff development

A final concern, which seems to some extent to have been solved in Case A, involved staff progression. As the Business Manager put it:

> "At present the Engineering hierarchy merges into the management hierarchy. This has led to some very incompetent middle managers such as programme managers."

His aim was to improve this situation either by increased management training or (it seemed, since he was not yet in a position to give details) by creating a different route for career progression as occurs in Case A for example.

THE COMPANY'S INVOLVEMENT IN YTS

Since the company was so heavily involved in Youth Training and the local ITeC in the city nearby this issue has been fully explored in this case.

Functions and Perceptions of YTS

1. "YTS is not seen as sweated labour in this area."
2. 90% of trainees go into employment in the company - "I am hoping this will continue."
3. YTS is marketed and advertised using the trainees themselves.
4. YTS acts as a buffer:

> "Children leave school in a lump - our natural movement (of staff) is on a rolling monthly basis. I could take four people a month quite easily ... but from schools they all leave at Easter or Summer. So you get this great flood of people on the market and you can only take a tiny quantity ... so I believe that YTS acts as a useful BUFFER. You've got these people for 12 months or 2 years and you can employ them at any time in that period ... as these periodic vacancies occur you can absorb your trainees as you go along." (YTS managing agent)

5. Our TS trainees are treated as employees. They don't wear a funny hat. "We've had the humorous situation of a YTS trainee actually instructing a graduate." (in driving a scanning electron microscope and also the ion implanter in its working operation).

Jobs done by YTS trainees in White's

1. "Everywhere where there is a job capable of being done by semi-skilled hands". Many would be "production operatives" employed in manufacturing.

2. A special category of operators exists: "operator in this business means artisan. These people are engaged on specialist equipment in the IC division."

3. Changes in Technology: The managing agent felt strongly that new technology is continually changing the job and the skills involved:

   "The sort of 'pick-up-with-tweezers' person is disappearing . . . it is 'the able-to-put-in-a-simple-numerical instruction to a microprocessor controller' person that we need."

   "We are running furiously to stand still, because the technology is constantly galloping away from us."

Career Progression

The progress of youth trainees through the hierarchy was well defined, with certain avenues clearly closed.

> "YTS trainees (below Trainee Technician Engineers) can go up to City and Guilds qualifications and become technicians or senior technicians. They couldn't become technician engineers . . . It is unlikely that they'd become associate engineers - that presupposes an HNC or better."

Links with the ITeC

Although links with the ITeC are strong - the manager is a former White's employee - the role of the ITeC was not seen as that of providing personnel for the company. Thus, "some ITeC people have been taken on, but only the odd one or two." A few work placements had been provided in computer operating or word-processing: "they can come in and very quickly make a contribution". (managing agent within White's).

I visited the ITeC and interviewed the manager. The ITeC links were mainly with small firms although there "aren't many around in the ...... area". Larger firms such as White's tended to have their own schemes for YTS:

> "Links with White's are a very minor consideration as far as we are concerned. Few ITeC trainees work there, or have work placement, because of their own scheme."

From the other perspective, the YTS manager within White's perceived that:

> "A lot of ITeC trainees are snapped up in the town in clerical functions, either working a word-processor or a small PC."

He felt that the ITeC type of training was useful in providing off-the-job training under very different circumstances from in-house training:

> "In an on-the-job situation you can't afford the mistakes . . . in an ITeC environment it doesn't matter."

He also felt that the training was geared to a certain category of trainee:

> "The ITeC offers specific computer training to those people who may have a flair for computing but not a depth of academic undertanding . . . they can drive software, they can handle equipment, they can load and access and do all the necessary . . . but they're not programming geniuses."

VIEWS OF EDUCATION AND TRAINING

Apart from the views expressed above on YTS, its functions, and the role of ITeCs within it, views were readily expressed on the products of higher education. The Business Manager had long since given up hope of "ready-made graduates, moulded like clay" coming forward and fitting straight into White's. He is now more of the view that higher education should provide the "basic principles"; companies can give the specific training.

The personnel manager felt that Careers Advisory Services could do more to improve interview techniques, CV presentation, letters of application etc. prior to interview. More generally it was felt that presentation skills, confidence and teamwork should be stressed in the personal development of potential recruits:

"We're looking for people with confidence."

In assessing teamwork, "we look at what they do in their leisure time".

These are important messages for the curriculum, hidden and explicit, of education and training at all levels, as well as extra-curricular activities.

GENERAL OBSERVATIONS AND ISSUES OF CONCERN

I found my observations of the two factories on the site extremely valuable, despite being told by one interviewee that it might not be worthwhile:

> "It's very unrewarding looking round this factory . . . I can point to a £1.5 million computer, but it's just a box . . . it's the same with the ion implanter, £1.5 million worth of ion implanter. I can't tell you exactly what it's doing because you might go away and tell somebody else."

The Design Centre

Here, work on designing chips was explained to me by a new graduate (1 year in White's) from Queen's, Belfast with a strong Northern Ireland accent. He will be referred to as K.B. The equipment used was made by Apollo of the USA with each work station worth in the region of £100,000. The "user interface" involved a large, high resolution screen, keyboard and mouse. K.B. was designing a new chip for the Ministry of Defence. It would take 770 man-weeks to design (at £1000/man week). The circuit would be especially hard to background radiation in space, using Silicon-on-Sapphire (SOS) technology. This was very intensive work, requiring a high degree of concentration.

All the design process was done using computers (VAX and Apollo). The design was then stored on magnetic tape to go to the Manufacturing building. Most of the designers were electronic engineering graduates (an increasing trend). Only one woman worked in design between her A-levels and a Cambridge degree in Electronic Engineering. K.B. was highly enthusiastic and involved in his work. He had no complaints about White's except that some of his work could be done by "non-graduates" e.g. routine placing of cells on the screen design; making connections. This was perhaps "technician work". He could then be involved in innovation and overall design strategy i.e. "an Engineer's real job".

Manufacturing

This aspect of the company's work involves wafer fabrication, assembly and testing. My first impression was of the extremely high cost of the equipment: "Up to £2 million for a testing machine".

Many operatives were women, recruited from the local labour market e.g. "housewives", "young girls". Much of the work, e.g. in making connections to chips, is very repetitive. Some of the unskilled assembly work is now done "off-shore" i.e. overseas in places like the Philipinnes, to use the cheap labour there.

As mentioned earlier, two grades of integrated circuit are manufactured

- low reliability (plastic sealed)
- high reliability, higher cost (hermetically sealed with ceramics or gold plated seal).

These are needed for the different markets which consume chips e.g. telecommunications; defence; space etc.

High cleanliness is involved - employees are almost totally covered during the working day to avoid contamination by skin debri.

The Gender Split

There is genuine concern in the company at the tiny proportion of women who go into the higher echelons. In 1986 no female technical graduates entered the company at all - the year before only "2 or 3 did".

There may be some positive discrimination towards women graduates:

> "... women have got a good chance I think ... if we're honest they might be less able and they'll still get a job with us."

The same problem exists below graduate level - Technical apprentices are almost exclusively male,

"They're all spanner jobs to the parents".

One female apprentice was taken on two years ago.

What are the causes of the gender split?:

> "It's parents. Parents still associate any kind of factory job with the traditional grind and smoke of industry ... and the number of girls who come in here and say 'I didn't know factories were like this'."

> "Parents aren't sufficiently aware and they have great influence on what happens career-wise". (Personnel Manager)

Praise was given for a then new initiative for girls/women aged between 18-25 to attract more women into engineering: the Technician Engineer Scholarship Scheme or TESS. This is an EITB initiative with 3 courses around the country taking students from "no electronics knowledge to Higher TEC".

Concern for the Future

White's had experienced 50% growth p.a. in the last 5 years, according to the Business Manager in I.C. He was optimistic about the future:

> "Orders are being picked up as one or two American companies have folded up."

Change and growth in the company have led to concerns, expressed by different staff. As discussed earlier, a recent graduate and a business manager stated concern that engineering graduates were doing jobs that could be done (more cheaply) by technicians. Evolution in the technology itself would have an influence on this issue, which would in turn affect training needs. One need would be for increased and improved Management Training, as engineers became team managers. Another continuing issue would be the future of graduate recruitment - two personnel managers were concerned at the future availability of high-calibre graduates and their own procedures for attracting and recruiting them.

PART C: CROSS-CASE ANALYSIS

In a sense, the case reports above "stand on their own" as portraits of individual companies in different sectors, and are therefore open to interpretation and analysis by the reader.

However, following the protocol set out in Table 41 of this chapter, the next stage of the inquiry is to examine the general findings emerging across all the cases, and also to begin to place these findings in the broader context of the other empirical studies and more generally other work in this area. This section of Chapter 11, therefore, concentrates on Level 3 of Stage V in the Protocol (see Table 41) and begins to address Level 4. The questions described as Level 5, i.e. normative questions about policy recommendations and conclusions going beyond the scope of the study, will be addressed in the final chapter whilst reviewing available evidence on information technology in education and employment.

The strategy for analysis across the five cases is reflected in the headings used below. For clarity, they largely follow the categories used in writing up the individual case reports although new issues and concerns emerging from across the case-studies are highlighted in the ultimate section.

PERSONNEL AND RECRUITMENT

Recruitment Patterns

An interesting feature of the five cases is that only one (Case D) is currently recruiting school-leavers. In this case the recruits were described as the super-O and super-A level candidates - perhaps people, as the interviewee hinted, who would have gone onto higher education anyway. In the other cases, recruitment was largely at YTS level or at graduate level. This may appear to lend support to the theory that developments in technology have led to a polarisation of skills in employment (discussed in Chapter 12). However, my own view is that the observed recruitment trends do not support the skill polarisation theory. They simply point to a tendency towards polarisation in recruitment itself. YTS, for example, is seen by many informants in the cases as an ideal scheme for recruiting at a certain level - it could even be re-named YRS, the Youth Recruiting Scheme. Those who described YTS as "a year-long interview", "a buffer between school-leaving and recruitment into the company" (to smooth out variations in seasonal demand) and a "back-of-the-neck interview" supported much of the previous evidence in the interview and postal surveys. Similarly, at the other pole, graduate recruitment channels are now well established (although traditions such as the milk round are being questioned). In addition, habit prevails. As expressed in Case A, if "people have no experience of recruits with HNDs taking jobs in the Company, then they'll go for a degree - a piece of paper which they do know."

It appears then that a polarisation in recruitment may be evolving, although its connection to the skills polarisation theories of Braverman (1974) and subsequent authors is not established. For example, it is clear that in some of the cases recruits entering through YTS are given excellent opportunities to enhance their skills, gain further education, and achieve career progression. These opportunities are improved by the growing number of further education and training options (see Case E for example). However, career progress of YTS trainees has clear limits in the cases studied. In case A particularly there are obvious barriers to YTS trainees even if they continue to gain qualifications. Without a good degree they will not progress beyond a certain point on the technical ladder. This issue is closely related, of course, to the problem of correctly using and fully exploiting graduate recruits, which surfaced as a key personnel concern in several cases. The present clear demarcation between "graduate" and "non-graduate" jobs in aspects of information technology, e.g. design of integrated circuits in Case E, is unlikely to be broken down though it may well be shifted. In other words, as several managers pointed out, IT jobs are being done by graduates which could well be done by non-graduates with adequate training. Thus the work demarcation would remain but would be shifted to a different level.

Changes in Technology

Evolution in information technology itself will also bring about changes in the apparent polarisation and demarcation within the workforce. This was most evident in Cases A and E. In the latter case, chip design would itself be influenced by changes in technology - a sort of incestuous cause and effect relationship. New developments in CAD would bring about changes in the role of IT staff at different levels. What remains unclear, as stated above, is the effect on de-skilling and skill polarisation which might result from such changes. The assumption that the introduction of new technology automatically results in de-skilling (Braverman, 1974; Whiston, 1977) is not supported by the case reports above. It may even enhance the work prospects of non-graduates in technical jobs.

The division of labour within IT employment, particularly in IT providers, is clearly subject to rapid change. This is partly due to changes in IT itself, but is also affected by the purely commercial concern of personnel management. In short, graduates must be fully exploited in order that the company should get its money's worth and that key graduates should be retained by achieving job satisfaction (see particularly Cases A, D and E on this issue).

It is also clear, from Case A particularly, that the permeation and growth of information technology towards new customers and into new markets will influence work in IT. Graduates (and non-graduates) in IT posts will be increasingly involved in sales and marketing i.e. in dealing with, supporting and even training customers. Thus the importance of communication will equal the requirement for technical expertise (Cases A and C for example). Information technology will be adopted and presented for the customer, not the customer for IT as may have occurred in the early 1980's. Another important trend for personnel and recruitment appears to be the increasing emphasis on software expertise to support hardware already in the field. Thus growth in IT employment, from the evidence above, may well be in software related work rather than hardware. This is supported by ACARD (1986) and by IMS studies (1986), although there is no reason to believe that this is a permanent trend.

One key issue which does emerge for the first time in the case-studies is the large and growing importance of personnel staff in developing IT in industry. This issue is discussed separately in the ultimate section of Chapter 11.

Networks for Recruitment

A final personnel issue emerging in the case-studies concerns the use of networks in recruitment. In two cases particularly (Cases B and C) the use of personal networks, the "grapevine", appeared to play an important part in recruitment policy. This occurred at one level in Case C where the management core of a rapidly developing computer group grew from personal contact where the predominant metaphor was of a "growing family". In the other case, recruitment at shop floor level was achieved by personal networks or "somebody knows so-and-so", i.e. the local grapevine. Such recruitment practices may help to establish a company such as C where a small dedicated, committed core of able people forms the nucleus of an exponentially growing concern. However, its use by other employers may well severely inhibit the chances of people outside the network to obtain work. It is particularly likely to militate against minority groups such as recent immigrants, and is therefore a form of institutional racism (Jenkins, R., 1986). In addition, the use of a local grapevine does not enhance national mobility of employees which may be an essential requirement for economic growth in IT. (Sinfield,1981, pp.45-47, provides a full analysis of the effects of personal networks in recruitment.)

The case-studies above give no indication, of course, of the extent of recruitment through personal networks though they do point to its existence and some of its possible effects.

PRIOR SKILL REQUIREMENTS AND SELECTION POLICIES

The case-studies placed the selection policies and skill requirements common to so many of the employers in the interview and postal surveys in a real and living context. The concept of "fitting in to the company", "of being a Smith's person", for example, was vividly illustrated in interviews and observations. Its importance in recruitment and selection is hammered home and made real by case-studies such as these. The ability to "fit in" was a common requirement at all levels, although technical strength and ability became an increasingly important prerequisite at higher levels of recruitment.

Requirements for skills, either specific or general, were rarely stated in any of the cases. The attitude of potential employees was seen as "the key" in many cases, particularly at YTS level although not unimportant amongst graduates. This is linked to the ability of staff to work in teams which again (as in the interview and postal surveys) emerged as a common requirement.

No interviewees in the case-studies would state prior requirements in terms of skills. Whilst probing in one case, the interviewee felt that "they should like computers", and not be afraid of them, but would not suggest either specific or general IT skills as prerequisites. This ties in closely with evidence from the earlier data.

A final area in which the case-studies reinforced and made real earlier evidence from employers is the importance placed on communication amongst staff. The ability to communicate was seen as vital at all levels, particularly with the emergence of IT into new market-places, and the support needed for customers in existing markets. Additionally, communication amongst staff within the organisation was seen as vital, nowhere more so than those cases centrally involved with using and providing information technology. Teamwork and communication were plainly observed to be part of everyday activity in the IT providers.

SKILL SHORTAGES

It has already been suggested in discussion that the issue of "skill gaps" and "skill shortages" is both conceptually problematic (Chapter 3) and perhaps overestimated in the light of available evidence (Chapters 8, 9 and 10). The case studies above support both these views.

Firstly, the notions of "skills shortages", "skill gaps" and similar concepts were not readily used by either personnel staff or other managers. These are categories or concepts which appear to be little used by employers.

In probing further, and employing the ideas of "staff" rather than "skill" shortages, personnel managers in the cases felt that the problem did not exist except at higher levels. In one case (B), the manufacturer felt that the problem of attracting staff of the necessary calibre would only occur at higher management levels. In another (Case D), the personnel manager felt that the company might possibly have difficulty in attracting graduates of the right quality and background, but felt that personnel problems at higher levels were largely of the company's own making.

It seems then that the issue of "skills shortages" is neither conceptually useful nor of major practical concern in the cases studied.

USE OF INFORMATION TECHNOLOGY

In all of the cases, IT is being used in some way in varying degrees. In the obvious IT providers, information technology is central to both process and product i.e. it is both an end and a means. At the other extreme, in the IT users, information technology is clearly only a means of making the enterprise more efficient and therefore by implication more profitable. The value of the case-studies lay in highlighting and sharply contrasting the use of information technology by two very different IT users. In Case B the company (from my observation) would have functioned far more efficiently and ultimately profitably if it had a strategy for using information technology. This applied not only to the management and administration of the company but also to the production process itself. The latter area, as one manager pointed out, involved "several factors before the equation was right". He had been concerned by hasty investment in CNC machinery/robotics by a neighbouring company which led to their liquidation. However, in the area of administration and information flow within the company, efforts had been made at introducing IT which seemed to lack a clear strategy or indeed any integration with the planning and management structure. It was suggested that this may have been due to lack of awareness amongst the management team of IT and its potential - the computer manager interviewed, in his harsher moments, felt that it may result from ignorance or even fear of computers at Board level. This situation has important implications for both future education and existing training needs. "IT awareness for higher level management" may be an urgent need which managers themselves are not aware of.

In contrast, Case D (a much larger organisation) have a clear strategy for using and developing information technology across the company. This was enhanced by the integration of IT management into Board level discussions, and by the apparently greater awareness of IT at higher levels of management.

Thus the apparently rather disorganised and ill-planned attempts to introduce IT in Case B were in sharp contrast to the clearer strategies of Case D. The computer manager of Case B felt strongly that "fear of computers" and to some extent ignorance at higher levels were major causes of the lack of exploitation of IT. I was unable to probe this further but those perceptions have important lessons for education, as do the case-studies themselves in considering the diffusion and appropriate use of information technology.

VIEWS ON EDUCATION AND TRAINING

Perceptions of education and training were many and varied in the case-studies, and individual views and opinions will not be considered in detail. One or two new concerns surfaced in the case-studies which had not emerged previously - these are considered later. Firstly though, the comments and views which coincide with those from the earlier inquiry are mentioned.

Industrial awareness again seemed to be welcomed by staff in several cases, as an important attribute in new recruits. How this could best be achieved was not always elaborated although several living examples (such as the PFUE scheme in Case A) are described in the case reports. At the same time however, an important theme in discussions was that education should be kept broad, or rather broadened further ("the most useful people to us are people who are broadly-based"). There seemed to be no sense of paradox in advocating industrial and commercial awareness alongside a broad-based education, certainly at school level. The sentiment of the recruiting manager in Case B (the school's job is to educate - "my job is to train, to be specific") was a common one.

Support for the Youth Training Scheme was unequivocal, although its role as a recruiting scheme (mentioned earlier) was dominant in the minds of at least two personnel managers. The functions of YTS inevitably vary across cases but it seems fair to say that its role is central in all cases except perhaps Case A.

Graduate recruitment played an important part in all cases except Case B. Its place (or rather lack of it) there was determined largely by the personnel manager's perceptions of graduates as academic and unrelated to the real world, particularly from universities. His view of the University system, whether right or wrong, deserves attention. How many manufacturers view higher education in the same way?

Perhaps the most important issue emerging from the cases was the issue of continuing education and training for staff. In some cases, especially C, the ability of outside agencies to provide the right training was fundamentally questioned. It was felt that in-house training, laid on and supervised by the organisation, would be "absolutely relevant" and under "total control". Similarly in Case A, staff training and development were carried out in-house by a "meeting of minds" - the training manager saw little need for outside involvement. Perhaps the experience of Case B where staff had received the benefit of outside further education and training but in one case, had left the company, and in another case had caused lack of faith in the company's use of IT, would lend support to that viewpoint. The case studies do shed some light on the tensions between in-house and outside training, although this is an area in urgent need of further exploration.

A tension similarly in need of more examination is the problem of releasing staff for training and development. This tension appears to be particularly acute for small, rapidly evolving companies such as Case C where the urgent need for staff to keep up to date in IT conflicts directly with the demand to "give their all" to the company. Tension must also occur widely in manufacturing industry (as in Case B) where the workforce has been pared down so much that "there is no spare fat" to allow staff release.

These two tensions in training must contribute directly to Britain's relatively low investment in training compared with France and West Germany (Labour Research, vol. 77(1), pp.11-13). The tensions cannot be explored further here but they surely merit detailed investigation if Britain's workforce in the IT area is to compete with its foreign equivalent.

NEW ISSUES AND CONCERNS EMERGING

One of the values of the case-studies was in reinforcing evidence and issues emerging in the earlier surveys, and in placing those in a real and living context. In addition, however, new issues arose which the previous inquiries had not been able to uncover. This perhaps illustrates the advantage of using case-study in supplementing other methods (Wells, 1987). All of the issues discussed below have important implications for employment-education links and for education generally.

Firstly, the great importance and influence of the employing organisation's background and ethos emerged strongly in the case-studies. The background and ethos of the company, whether dating back to 1970 or to 1725, has a tremendous effect on its working practices, its career structures, and its recruitment policies. The latter particularly is important in the education-employment interface at all levels. The case reports show that "the ability to fit in", the capacity to work with existing employees, and whether or not the new recruit is a "Smith's person", were paramount in selection (Herriot, 1987, elaborates on the concept of fitting in). This pressure at the education-employment junction must exert an extremely conservative influence on education for employment and careers advice within it. It must also serve to maintain the status quo - even in a rapidly changing field such as information technology. Certainly, recruitment policies with such unwritten laws within them, would seem to be doing little to affect existing working practices and career structures. Such policies must surely also disadvantage existing minority groups in society. A similar effect arises from the use of personal networks (the "grapevine") in recruitment which was so prominent in Cases B and C though at very different levels (discussed earlier).

Perhaps these are issues which should be addressed in the future development of the Youth Training Scheme, which (as the case reports show) is so central to recruitment at a particular level.

A second issue emerging in the case-studies (in particular in Cases D and E) concerns the deployment and "exploitation" of staff once they are in post. This was an issue which the interviews and postal survey failed to bring fully to light but is of major concern to personnel staff, and is closely related to the problem of poaching (see exploratory interviews and Virgo, 1986). On the basis of these case studies it seems that companies are examining closely their use of graduates and the demarcation between (say) graduate engineers and so-called technicians in the light of developing technology. The examination is being made not just for the purpose of saving money (as in Case E where technicians might be able to encroach upon the work of more highly-paid graduates) but also with the aim of increasing job satisfaction of high-calibre staff (as in Case D) and thus the likelihood of retaining them in the face of increasing IT poaching (Virgo, 1986).

The general issue of the education needed for jobs was examined by Berg in 1970. He pointed out a growing tendency at that time for people to be in jobs which utilised less education than they had. Berg suggested that, in some areas of employment, workers with less formal education but more experience may perform better than their "over-educated" counterparts. This issue may be worth re-opening in the light of continuing rapid advances in information technology. The debate cannot be explored here - it is simply signalled as an area in need of further research as information technology evolves. An empirical study was recently carried out by Campbell & Warner (1987) who examined 26 British firms for the effect of new technology on working patterns and skill requirements. This is worth discussing briefly in its relation to the cases. They conclude that the "tendency for large companies to demand more highly-qualified people than they need at technical level" continues. They suggest, as do the case-studies above, that the role of the "technician" will change. This relates particularly to one comment by the YTS manager in Case E that they would need not the "pick-up-with-tweezers" person but the "able-to-put-in-a-simple-numerical-instruction" person at technician level in the future. Campbell & Warner's final conclusion of relevance to this inquiry is that "shortages of off-the-shelf graduates should provoke moves to reduce the requirement for graduate-intensive design and development". Once again this conclusion ties in with some of the evidence presented in the case reports.

A final issue of equal importance in determining the workforce in employment and with it the development of information technology is the role of Personnel staff in shaping a company's future. This emerged strongly in the case-studies, particularly in those IT providers which depend totally on a high-level of technological ability to develop and progress. No longer can a personnel manager retain a purely REACTIVE role in responding to gaps, vacancies and shopfloor demands. The job must surely be a PROACTIVE one in developing a suitable workforce for future development. For industries involved in IT the quality of their staff is crucial - their long term survival and growth depends almost totally on their ability to attract, develop and retain staff. This is particularly true in the attraction and satisfactory exploitation of high-calibre graduates which emerged as a central issue for personnel in almost all the cases studied.

In knowledge-intensive industry, i.e. every IT provider and most IT users, it is the workforce which (almost by definition) matters more than any other factor. This fact had been clearly recognised by the personnel staff in Case A, a rapidly growing company in the forefront of IT development. To them, personnel management was the key to the company's future. Their present ability to attract and retain high-calibre technological staff clearly sets a standard with which others must compete for their own survival.

It is interesting to reflect that a 1987 survey (EXECUTIVE POST, No. 369, 3.12.87) showed that over one third of the 100,000 people working in personnel in Britain are women (c.f. the tiny proportion employed in IT industry: IMS, 1986). This is one area where women appear to have made progress in breaking down barriers. If the role of personnel staff is to be crucial in shaping the IT industry (as the cases suggest) then perhaps the women involved in IT personnel could take a more proactive role in encouraging female recruits into IT posts, particularly a professional level.The general issue of women and information technology in both education and employment is a vital one for the future of IT in industry - this is one of the issues explored in the final chapter which now follows.

PART FOUR: EDUCATION FOR EMPLOYMENT IN IT:

SUMMARY, ANALYSIS AND RECOMMENDATIONS

CHAPTER 12

EDUCATION, EMPLOYMENT AND INFORMATION TECHNOLOGY

In Part One the background to the subsequent inquiry was sketched in order to place it in its broader context. In Part Two the main findings from the empirical enquiries were reported. In this concluding chapter the major findings emerging from the study will be considered, compared with previous work in the area, and fully discussed. Certain explanatory frameworks will be suggested and compared with other patterns and explanations which have emerged in previous work or been suggested in other published discussions.

Finally, the broader issues in the debate on education for employment will be considered particularly as they relate to information technology - this debate in turn relates to the fundamental aims of education in a "technological age". Those aims are considered in the light of the above inquiries.

In order to act as signposts for the reader, a list of the main headings in Chapter 12 is given below:

Educational Provision and Employers' requirements: match or mismatch?

Women and information technology

Dilemmas in Vocational Education

Skill requirements and recruitment strategies in information technology

Approaches to IT education and training: skills or native abilities?

Education for employment in the information age.

EDUCATIONAL PROVISION AND EMPLOYERS' REQUIREMENTS: MATCH OR MISMATCH?

It has already been recognised that the relationship between education and employment is a highly problematic one. This point was raised in Chapters Two and Three, and reinforced in a real way by the reports of the inquiries which followed in subsequent chapters. Problematic notions such as "the needs of industry", "the demands of employers", "skills for the future" and even the notions of vocational education and training themselves were raised as concepts to be handled with care. Discussion of those concepts is postponed to a later section of this chapter where they are placed in the context of earlier discussions (Edgley, 1977; Entwistle, 1970; Jonathan, 1983; Reeder, 1979 etc.) and also the main findings of the above inquiries. For the purposes of this section, however, a "naive" comparison is made of provision with demand in line with one of the stated aims of Chapter 1. This naive comparison rests on a crude model of education which sees the training and education systems as the "producers", and employers as "consumers". A critical analysis of that model is given later - by-passing that critique for now, how do the education and training provision investigated in Chapters 4, 5 and 6 match up to the demands of employers examined in Chapters 8, 9, 10 and 11? Several broad statements are made below in considering the match within a crude producer-consumer model. The issues raised are considered in their full complexity in the later sections.

Courses for Horses?

Firstly, there is little evidence to show that school examination courses in computing, or more generally IT, are a specified requirement of employers. This assertion is clouded by two issues. Firstly, those courses may be of indirect value in that they often provide young people with the IT awareness, the motivation towards computers or simply the basic familiarity with IT which does seem to be a common requirement. Secondly, from the evidence in the above chapters, a steadily decreasing number of young people are being recruited directly into employment from school. Thus the general notion of any school subject (at say GCSE level or even A-level) being a direct employer requirement or of direct vocational value may be an obsolete one. This issue will be explored in the more general discussion later.

If school courses are not directly required by employers then their value and their effects must be judged *using other criteria*. Leaving aside their intrinsic worth (for which a case could surely be made in Computer Studies) then what effects do examinable courses in Computing have on other factors relating to future employment and IT? Strong evidence exists from both the interview and electronic surveys above that an excessive concentration on computing courses for a minority does severely restrict the aim of IT awareness and familiarity for all. This would not occur in an ideal world of course, but resource and in-service training provision are unlikely to increase in the near future to a degree which would achieve that aim. In short, where examination courses have dominated, IT awareness has suffered. This is one general pattern in education where (if it occurs) employers' requirements have not been met by educational provision at school level.

Two other adverse effects may also have resulted from the growth of examinable Computing Courses in schools since 1981 (traced in Chapter 4). Firstly, the perceived nature of those courses and the resulting dominance by males may well be a contributory cause to the declining number of women going on to computing courses in Higher Education and in turn the acute shortage of women in IT employment at graduate level and above. This issue is explored fully in a subsequent section in the light of recent work by Aylett, Dain, Morton and others. Secondly (affecting both sexes of the population), the shortfall in the supply of science and technology graduates to employers may have been exacerbated by the growth of Computer Studies in schools. Teacher shortages in maths. and physics (a concern of many employers in the above inquiry) must have contributed to this shortage during the decade. Evidence exists from the inquiries, and from major research by Straker (1987), that Computer Studies teachers have been largely drawn from Maths. and the Physical sciences. They have certainly not been trained in their own right (Wellington, 1985b). Thus it can be postulated with some certainty (and with the benefit of hindsight) that the growth of school Computing courses in the 1980's has contributed to teacher shortages in the foundation subjects for future science, technology and engineering graduates, in turn exacerbating the key shortages in parts of the IT industry.

Two hypotheses have therefore emerged from the research reported above, in conjunction with other work, which I would like to put forward in considering the consequences of school IT education through the 1980's:

1. Where examination courses in computing have dominated, IT awareness for all has suffered in a finitely resourced environment.
2. The increase in school Computing courses in the 1980's may have partially contributed to the shortfall of key personnel for the information technology industry.

Counter-vocationalism

A new concept is introduced at this point which, it is hoped, will be of value in considering the education-employment relationship.

A situation in which the consequences (either intended or more probably unintended) of an innovation in education transpire to be counter productive in relating education to employment will be termed COUNTER-VOCATIONAL. A counter-vocational innovation may in fact be counter productive from three different perspectives. Firstly, from an individual's perspective a given innovation, course of study or qualification may prove to be of no value or even of negative value in enhancing that person's employment prospects. Secondly, from the varied and often idiosyncratic perspectives of individual employers a given innovation, course of study, or qualification may be considered to be counter-vocational in not fulfillng their immediate needs. A situation occurred in Case B for example where the possession of a degree was counter-vocational. However, from the third and much broader perspective - the needs and development of the economy and employment generally - a different perception of vocational education may occur. A given innovation, course of study, or qualification may be of vocational value to an individual or an employer but may prove to be counter-vocational with respect to the economy as a whole. Conversely an innovation may be counter-vocational to an individual or an employer, but may in fact be of vocational value to the economy generally.

The notion of counter-vocationalism introduced above will be used in subsequent discussion, although it may also be useful in examining some of the evidence presented earlier on IT in education and training.

It seems that some of the trends in IT education sketched in Chapter 4 and examined empirically in Chapter 5, may have actually been COUNTER-VOCATIONAL in two areas. Firstly, certain trends may have inhibited the provision of IT awareness and familiarity for the large numbers in the future who will use IT in employment, which is both a clearly stated demand of employers and a pattern of need emerging from data on employment (Chapter 2). Secondly, IT education at school level may have been counter-vocational by aggravating (albeit in a small way) the shortfall in the supply of key staff who will largely be the IT PROVIDERS of the future. This has been particularly true in the case of women (see later section).

ITeC Courses and Employers' Demands

On the face of it the issues of vocationalism and (as I have termed it) counter-vocationalism are less complex in the ITeCs than in schools. Their stated role, as Chapter 6 showed, is to prepare young people for employment in IT. Their success could therefore be evaluated in those terms. Given that narrow brief, the ITeC programme and more generally the YTS have fulfilled some of the needs of employers in IT. It seems, from Chapter 6, that this is particularly true in the USE of IT in employment rather than in the provision of IT, either hardware or software. Evidence from Chapter 6 shows that youth trainees with IT skills have been far more successful in gaining employment in the area of the so-called "electronic office" (i.e. word-processing, databases and spreadsheets) than in Electronics and Computing. This matches closely the evidence on employers' needs from the interview and postal surveys, and each of the case-studies. It appears, as stated earlier, that employment in IT has a certain hierarchy which is closely related to levels of education. Thus the ITeC trainees and other YTS graduates are helping to fill "a need" at a certain level and in a certain area of employment.

Two questions can be posed however, in considering this aspect of youth training in crude producer-consumer terms. Firstly, could the considerable resources which were devoted to the ITeC programme have been more effectively channelled elsewhere? Chapter 6 shows that the resourcing of ITeCs is far superior - in terms of staffing, hardware and software - to that of the school system. School teachers are understandably envious (as they were in the "Skills for the Future" project) of this level of resourcing and are entitled to speculate on the influence it might have in school IT education. In the interview survey of ITeCs, a small number of staff themselves speculated on whether ITeCs were doing "the right job for the wrong people". One of the more cynical interviewees questioned the wisdom of providing a labour and capital intensive programme for "the bottom end of the intellectual tree" (a view of trainees not fully supported by the evidence in Chapter 6 incidentally).

Whether or not the ITeC resources injected since 1981 were deployed most effectively in meeting the needs of employers must remain a hypothetical question which cannot be answered. A second question which can be posed however is the issue of whether the attractive ITeC programme, and indeed other YTS schemes, have directed young people away from further and higher education. This must be posed as a key issue for the future in considering the "needs of industry" at higher levels. Evidence has been put forward in such publications as the Times Educational Supplement that the increase in the numbers opting for YTS is related to the falling proportion of 16 year olds staying on for full-time education ("Fewer stay on as YTS recruiting takes off", T.E.S., 6.6.86). No cause and effect relationship has been established but this is a serious concern in considering the ability of education and training provision as a whole to meet the needs of IT industry at all levels. Indeed, this is a basic dilemma for vocational education - increased "vocationalism" at one level may prove counter-vocational when the producer-consumer model of education-employment is examined holistically. This dilemma is explored fully in a later section in considering the notion of "pipelines" from education into employment and also Norton-Grubb's (1984) examination of vocational preparation for hi.-tech. industry.

In defence of the ITeCs it must be stressed that some of their leavers have been going on to further education. However the inquiries above suggest that those numbers were actually less (at 9%) than the proportion going on to unemployment (15%: Table 23). More generally, it must also be re-emphasised that few ITeCs see their function purely in the crude vocational preparation terms adopted above. Chapter 6 indicates the wider role perceived by ITeC managers in terms of personal development and general abilities of trainees, couples with a measure (in some centres) of positive discrimination towards disadvantaged groups. The broader abilities developed by education and training, and their match with employers' demands is the next topic in this process of comparison.

General Educational Outcomes and Employers' Needs

Comments have already been made (in the postscript to Chapter 10) on employers' more general requirements of the education and training systems. Some of those requirements were reinforced by the case-studies following them although the value of the case-studies lay in seeing at first-hand the reality behind the rhetoric. As a result some of the general messages below may rightly be regarded by people in education with certain caution.

A common message received was that employers (not least those heavily involved in information technology) favoured a broad-based, general education from the school system. However, the case reports indicate that interpretations of that requirement vary widely. Some perhaps did have in mind the idea of a liberal education (Bailey, C., 1984; O'Connor, 1982). For others, however, the terms implied the basic abilities of literacy, numeracy and communication, or simply the 3 R's. This is just one area where employers' stated needs must be handled cautiously. Another case where caution is needed is in the common requirement for personal qualities expressed by employers and highlighted in the postal survey (e.g. Table 37), the interviews and subsequent case-studies. A key message for education emerging from this inquiry is that personal qualities are and will be valued highly by employers in all sectors - this message is reinforced by the consideration of employment patterns in Chapter 2. However, this message needs to be qualified by the reality of employers' selection strategies, not least in the area of information technology. Personal qualities are not FUNCTIONALLY PRIOR to levels of educational achievement or academic qualifications. The data presented above consistently suggest that the level of education/training of recruits is closely related to the level of IT work carried out. Similarly, in selecting recruits employers value personal qualities given a certain prior level of achievement. No level of personal abilities or qualities will enable (say) a YTS trainee to compete with a graduate from higher education in certain areas of IT employment. In other words, personal qualities are valued within levels of achievement but will not enable people to transcend those levels. They are often enhancing rather than enabling attributes. Logically, personal qualities are in a different league to levels of attainment.

This is not to devalue the development of personal qualities however as a vital aim for education in the future - I am simply suggesting that the development of personal qualities should not be given greater priority, or nurtured at the expense of, educational achievement. To do so would be to detract from the value of education to the individual as preparation for employment.

This issue relates closely to the position of such areas as "Personal & Social Education" (PSE) in the curriculum. Should it remain (as it is in many cases) in the domain of the hidden curriculum and the murky area of "school ethos" or should it be placed firmly in the explicit, timetabled curriculum? This is a huge debate which cannot be explored here (PASTORAL CARE IN EDUCATION, vol. 5, no. 3, 1987 provides a special feature on PSE). However, the message emerging from the above enquiry is that PSE should be given greater status in education and training at every level from school to higher education. If this necessitates placing it firmly in the explicit curriculum of schools, youth training and degree courses, then that course must be followed providing that it is timetabled as a requirement for all and not viewed as a soft option for the least able.

One final area for education generally which is seen almost universally by the employers in this inquiry as a valuable aim is that of industrial or commercial "awareness". There seems to be less ambiguity and hidden complexity in this demand than in some of the issues above, although it is possible to attribute political overtones to it (Edgeley, 1977; Jonathan, 1983). Provided that the notion is interpreted liberally (Dearden, 1985) then surely its value as a part of education in developing critical awareness of industry, commerce and employment generally cannot be disputed. Law (1986) provides a practitioner's guide on widening the "pre-vocational franchise" to include a variety of interests, across a number of boundaries.

Graduate Supply and the Needs of Employers in IT

The inquiries above have confirmed previous studies, current press reports, and regular statements from bodies such as ITSA that the key personnel shortages in IT are at graduate level and higher.

The shortages of graduate supply into employment in IT were well documented prior to this inquiry (NEDO, 1984; the Butcher Committee reports: DTI, 1984) and have been examined in detail more recently by the Institute of Manpower Studies (IMS, 1986). The IMS examination of "information technology manpower" (sic) predicted that IT skill shortages will remain a problem "at least until 1990". From their evidence, Connor and Pearson of the IMS estimate that demand for graduates for IT work may increase by 50% by that time. The education system faces a huge problem and certain fundamental dilemmas (examined later) if this demand is to be met. Demographic trends exacerbate the problem. The sharp downturn in the size of the 18-year old population in the late '80s and early '90s combined with the current shortages of school physics and maths. teachers could mean that there will be a lack of qualified A-level students to fill the extra places for IT and engineering course in higher education created by the Government initiatives earlier in the decade (Table 14). This effect of demography could in turn be worsened if the attractions of YTS (both financial and vocational) divert students away from the "deferred vocationalism" of an apparently academic route. This would indeed be the ultimate irony of the "new vocationalism" of the 1980s (Bates et al, 1984) if initiatives at one level were to undermine those at another.It may transpire that several of the initiatives in IT education of the 1980s (Table 14) may appear, with the benefit of hindsight in the 1990's, to have been in direct conflict. The "islands of IT education" referred to in Chapter 4 may be fruitfully seen as branches or outlets from a pipeline linking education to employment.

Following this metaphor, certain outlets (prompted by initiatives and Government programmes) may have reduced the flow in other parts of the pipeline which may be more crucial to the future of IT industry. I will refer to this effect as one aspect of counter-vocationalism in exploring the pipeline metaphor in a later section.

Before that however, three clear indications have been given by employers in the above inquiries of ways in which the graduate supply shortage into IT employment highlighted by IMS could be eased. Firstly, many employers have indicated that the discipline net from which graduates are drawn for IT related employment could be considerably widened (Chapters 8, 9, 10 and 11).The IT constituency could include graduates in music, foreign languages, archaeology and philosophy (to take just four examples) in addition to science, technology and engineering. This relates to the fundamental discussion of Chapter 1 on the nature of information technology itself. If IT is perceived in the future as a CONSTITUENCY rather than a discipline then this change would be enhanced. Of course, the situation will still remain that certain jobs (as in, say, Cases A and E) can only be done competently by graduates in certain disciplines e.g. electronic engineering. But an increasing number of jobs will be open to a wider range of people as IT itself develops (exploratory interviews, Chapter 8; Aleksander, 1986) and the emphasis grows on customer support, marketing and commercial skills (IMS, 1986), and fourth generation languages (Computer Weekly, 26.11.87).

A similar widening of the IT franchise can occur at the school-higher education interface. When Salford University launched a new undergraduate degree in Information Technology they deliberately did not specify a requirement for A-level Maths. and Physics. As a result they were able to fill their course with students from a range of backgrounds, including a healthy proportion of women (figures supplied by the Academic Director, John Larmouth). The course is closely related to employment and appears to be meeting the requirements of a number of employers involved in its planning.

A second means by which the demand-supply equation might be balanced in future at graduate level has emerged strongly in the interviews and case-studies above. Employers involved in IT are questioning their deployment and exploitation of graduates (see Cases D and E particularly). This issue has already been discussed above - it surely merits further examination by IT employers themselves and perhaps detailed research by an outside body. There may be a whole category of "IT employee", not currently being provided by education and training, which could ease the present and predicted demand for graduates and fulfil a valuable role in industry.

Finally, one obvious category of employee is missing at the higher levels of IT employment - the category referred to by Alvey as the "untapped half of the population" (House of Lords, 1984). Tapping this category could alone ease the supply shortage of "IT Manpower into the 1990s" (IMS, 1986).

WOMEN AND INFORMATION TECHNOLOGY

A full treatment of this issue would require a thesis in itself. What I hope to achieve in this section is to relate the findings and indications of the above inquiry to some of the data now available on the position of women in education, training and subsequently employment in information technology. As before, the problem will be analysed purely in pragmatic, utilitarian terms leaving aside the broader issues in technological education.

The Problem

The problem can be viewed from two angles: education and employment. Although the above inquiries did not deliberately set out to explore gender issues, it became clear that they could hardly be avoided.

Take employment first. The numbers of women observed or interviewed in positions of high responsibility in IT was virtually nil. This was strikingly true in the whole of the interview and case studies. Only Personnel Managers proved to be an exception (Chapter 11). This observation is supported by previous studies. The IMS (1986) examination of IT personnel summarised their estimates as follows:

> "The IT profession is characterised by a low representation of women, although large numbers of women are employed in IT at lower levels on data input and electronics assembly operations. Women typically represented only 1-2% of a company's electronic engineers, although they could be as much as 10% in the larger electronics and telecoms groups. In software jobs, the proportion of women was generally higher, averaging 15-20%."

These estimates are supported by the small amount of other data which is available. Haughton (1987) states quite simply that "the higher up the company you go, the smaller the proportion of women found" (p. 34). Figures quoted by Caroline Blaazer, head of the IT unit of the Industrial Society, are used to support her argument. In a later article by Blaazer, women are said to provide only 2% of data processing managers and 18% of programmers (c.f. IMS above) but an astounding 95% of data preparation staff (Blaazer, 1988). It is clear that the level of education reached by recruits is not the only factor correlated with the level of IT work required of them (figure 10 and Table 36, Chapter 10). Sex is also a vitally important determinant.

The situation in education and training is equally serious although it is more easily examined from available data. Figures are readily available on the numbers of girls taking school computing courses and subsequently entering higher education in computing. Data on the growth of school computing courses was shown in Chapter 4 and examined empirically in Chapter 5. DES statistics on boy/girl entries, shown graphically in figure 14, indicate clearly that the gap between boys and girls entering 'O' and 'A' level courses in computing grew steadily wider from 1981 to 1985.

This gap in itself may not be a serious factor on its own in restricting the entry of women into the higher echelons of IT employment, since the inquiries above suggest that school computing courses have little direct vocational significance. However the situation is more serious when figures for higher education over the same period are studied since the data in Chapters 9, 10 and 11 reveal clearly that these are the levels from which recruitment of IT "professionals" (IMS, 1986) almost exclusively occurs. Data from the Universities Central Council on Admissions (UCCA) on entries to undergraduate courses since 1979 are shown in Table 43. The figures show that the percentage of female students dropped from 26% in 1979 to 14% in 1986, with a drop in actual numbers from 438 to 261. The peak in female admissions occurred in 1981, and subsequently declined steadily. Julia Dain (Dain, 1988) analyses these trends, discusses their effects, and suggests possible counter-initiatives (summarised later).

Equally shocking figures are discussed by Aylett (1986) in a more specific context. She analyses the remarkable drop in applications from women to computing courses (B.Sc and HND) in Sheffield Polytechnic since 1981. From a level of 20% in 1981-2, applications from women dropped to only 6-8% in 1985-6. This represents an even sharper drop than the UCCA figures. Aylett goes on to analyse patterns further, to suggest hypotheses and (like Dain) to put forward positive initiatives.

Gender gaps clearly exist in school and higher computing education. But they are nowhere more marked than in the ITeC training within the YTS scheme. The quantitative and qualitative data shown in Chapter 6 need not be repeated here. It must simply be re-emphasised that the gender problem in this source of IT personnel exists markedly at 3 levels: in the initial applications and admissions of trainees; in their curriculum choice during training; and in their eventual destinations after YTS.

These are the problems facing education, training and employment - they must jointly attempt to solve the crisis for utilitarian reasons, if not on the grounds of intrinsic inequality. What might be the causes of these gender differences and (later) what initiatives could be taken to cure them?

The Causes: Four Hypotheses

Again, a huge amount of literature and research on the gender issue has been produced and cannot be considered here (Whyte, 1985, provides just one general summary). However in this particular context few hypotheses have been suggested on the causes of the problems outlined above. As Aylett (1986) suggests perhaps too strongly: "in the absence of any research into the problem, we must form our own hypotheses". Following her line, I have distinguished four possible explanations for gender problems outlined above. All are worthy of further research and examination since they are so vital to the future of IT industry.

1. Computing in schools is driving female students away from the subject. This has been particularly marked since the push of microcomputers into schools in 1981 (see figure 14 and Table 43).

Interestingly this was first suggested in writing by Mrs. M. Davies, a tutor at Hatfield Polytechnic, in 1984 (House of Lords, 1984: Written Evidence, page 112). She implicitly blamed the Micros. in Schools scheme, and subsequent programmes, for generating the idea of computing as a male culture. Aylett argues in a similar way that the content of school courses has portrayed computing as 'hard', 'abstract' and an adjunct to Mathematics (also Ward, 1983). This portrayal has been reinforced by the absence of new training for IT teachers and the consequent encroachment by staff from the male dominated physical sciences and Mathematics.

Considerable support for these ideas is available in the data presented in Chapter 5 on the nature of courses, their stronghold on resources and the backgrounds of the staff teaching them - however, this hypothesis requires a fuller examination if lessons are to be learnt for the 1990s, on increasing the supply of women into higher education and employment in IT.

2. The spread of microcomputers into the home has contributed to the gender gap in school courses, higher education and IT employment.

There is some evidence to support this view, though again further research is needed. During the life of the MEP, its Primary project found that twice as many boys as girls have access to the micro. at home - in all households, boys were 13 times more likely than girls to be using them.

Considerable research on patterns of teenage computer use and attitudes towards IT has been carried out by Fife-Schaw, Glynis Breakwell and others (Fife-Schaw et al, 1986; Breakwell et al: 1985, 1986 and 1987). Breakwell reports that many home computer games serve to initiate and maintain interest in computers. If - as Breakwell, Aylett and others suggest - those games are preoccupied with aggression and competition, then home computer use may well deter teenage girls particularly:

> "The literature, the magazines, the arcade game software all very much reflect the culture of the male adolescent and may therefore repel girls." (Aylett, 1986, page 3).

Parental influence is also a key factor. The MEP Primary project reported that in only 4% of households was the computer used by the mother. Fife-Shaw's work (Fife-Shaw et al, 1986, p.160) stresses the importance of parental influence in determining teenagers' attitudes.

Home computer use, teenage subcultures, and parental influence are surely vital factors in the crucial 14-18 age range in determining vocational attitudes. This second hypothesis therefore merits further research.

3. The image portrayed of computing and information technology in the media reinforces sexual stereotypes and deters women from professional careers in computing.

Evans and Hall (1987) accuse the media of promoting a "macho" image of computing:

> "The 1980s have seen computing become increasingly a male-dominated world. In the media, advertising and computer magazines, computing took on a very "macho" image. Most of the software available at the beginning of the microcomputer revolution was designed for the male stereotype. Careers in computing became more prestigious in the eyes of society, with salary levels attracting the high-flyers and the computer games industry offering instant fortunes to the dedicated enthusiasts."

The media image of IT may be a deterrent to women. Reality may be an even more powerful factor. My own observations (Chapters 10 and 11) suggest that the working environment and working practices in IT employment may serve to reinforce sexual stereotypes - particularly in the minds of school students or youth trainees undergoing work experience (in, say, TVEI or YTS). Women are commonly seen using computers and VDUs but they are largely "working away at the keyboard". Few men are seen working alone at the keyboard, but they may be seen in small teams working around a VDU. The more prestigious input device in IT, the "mouse", is the province of the male. Haughton (1987) discusses the "office culture" and its influence on women's success in IT careers:

> "Women are no less ambitious, motivated or well-qualified than men - many do not succeed because of the office culture. It can be very lonely for a woman in an area dominated by men. Chummy lunches, boozy evenings in the pub, office jokes and innuendo all tend to isolate and exclude her - sometimes even deliberately." (Haughton, 1987, p. 34)

This third hypothesis - that perceptions of the "IT working culture" are an influential factor - is related to the fourth, which concerns women's own self-perceptions.

4. Obstacles to women's progression and careers in information technology often exist in the mind of the woman herself.

This is argued, for example, by Haughton (1987) in quoting Caroline Blaazer:

> "A great hindrance in attracting women to computing lies in their own perceptions of themselves, and their assumptions and misconceptions of computing. They don't see themselves as having the right sort of skills, they don't feel secure enough in themselves to take risks or experiment with technology in the way that men do."

She suggests that, from an early age, women tend to underestimate their scientific and technical ability. Clearly, some of the blame lies within the education system itself and the nature of courses within it, and therefore relates back to the first hypothesis. However, Breakwell's extensive research suggests that attitudes to technology are also strongly influenced by the father and his job. For example, fathers with "high-tech jobs" provide their children with a role model and tend to provide computer facilities at home, which motivate and develop positive attitudes. (No conclusions were drawn on the father's influence on a daughter relative to that of a son, however.)

Of the four hypotheses, this final claim appears to have the least evidence to support. Breakwell, Fife-Schaw and others have led the way in developing methods and collecting some data, but much further work remains to be done if female self-perceptions are to be blamed as a root cause for lack of motivation and achievement in information technology.

Suggested Lines of Action

It would be difficult to confirm any of the four above hypotheses with any certainty. However, all are at least plausible and on that basis initiatives and remedial action can be taken in relation to them. The purpose of this section is not to spell out or propose initiatives in detail but to suggest (on the basis of the empirical inquiries and the literature considered above) certain lines of action which could be taken to improve the situation in the future.

Lines of action can be roughly divided between four areas in which initiatives could be taken: education, employers, home, the media.

It is in the first area that most initiatives have been undertaken - in the latter three there is much ground to be made up. Aylett (1986) suggests that school computing courses should be made less "narrowly technological" and more "socially relevant". Since 1986, of course, changes have been made in GCSE computing and information technology courses (see Chapter 4 on TVEI courses particularly). Perhaps a more important aim in the development of IT education in secondary schools is to speed the diffusion of IT across the curriculum so that all teachers and all pupils have access to it. As the findings of Chapter 5 indicate however there are considerable barriers (of humans and hardware) to this process. In 1988, information technology is still very much the domain of the male teacher, from a Maths. or physical science background, and the male pupil. The other initiatives which Aylett (1986) and Dain (1988) suggest are therefore partly undermined or pre-empted by the school process. As remedial measures however they are surely worth pursuing -

Dain (1988) reports a special one-week residential course for 6th form female students as part of a continuing Warwick WISE project to attract more women into computing. Similarly, Aylett suggests taster courses (residential and non-residential) for female students. Aylett also suggests ways of attracting mature female students into higher education from (for example) Women's Technology Training Workshops.

Another important initiative aimed at increasing supply into higher education is the HITECC programme: Higher Introductory Technology and Engineering Conversion Course. The one-year programme is aimed at preparing candidates (of any age) without science A-levels for a degree or diploma course in engineering or technology. The HITECC courses have been successful in attracting women, from a range of backgrounds (fully reported in 'Women show the way from art to science', The Times, 17.11.87). Such conversion courses are surely a vital source of personnel for the future as both the number of 18 yea-olds and the proportion taking Maths. and Physics at A-level decreases. Those people particularly who opted out of the physical sciences as adolescents in school can be given a second opportunity.

There have been a number of initiatives from education itself which have not been considered here - the Equal Opportunities Commission, for example, has been highly active in this area in producing documents, leaflets and posters, and in supporting research and development by others in all stages of education. The areas, it seems where least action has been taken are by employers, in the media and in home computing. These are surely three areas where initiative needs to be taken if the actions in education are not to be totally undermined.

Employers, for example, were accused by the IMS (1986) report of making little "positive effort to attract or retain women in their own organisation". My own inquiries, particularly as reported in Chapters 9 and 11, indicate that employers are concerned that few women are entering IT employment at professional level (e.g. in Case A) but few have taken concrete steps to improve the situation.

Indeed the reality in employment is perpetuated by initiatives such as work experience (TVEI) and work placements (YTS and ITeCs). Young people involved in such schemes will have many of their preconceptions reinforced by observing information technology in employment. Work experience forms a new link in a vicious circle. As Blackman (1988) puts it in his analysis of "socially ascribed discrimination":

> "The introduction of work experience and vocational courses without a thorough check on the transmission of the values and relations from the world of work may possibly exacerbate class and gender differentiation". (Blackman, 1988, p. 52)

This is just one of the paradoxes of the "new vocationalism" which are explored in the next section.

The two final areas which are perhaps the least penetrable but where action is most needed are in the home and in the media. The "explosion in home computing" (Alvey, 1982) has had effects which have barely been explored. Breakwell et al (1985, 1986, 1987) have made a vital contribution here in showing the male dominance in hardware, software and the associated subculture, and in pointing to its effects on future attitudes and job aspirations. Work is needed in examining the nature of home computing, its links (if any) with education, and its connection with educational and career choices. Positive action is needed in promoting home computing for both sexes which involves more than mindless, aggressive games or habitual "hacking". (Aylett, 1986)

The home computing "subculture" with its software shops and network of magazines is itself part of the media influence which needs to be examined in this context. Once again, research is needed in studying the public face of information technology in newspapers, magazines, radio and television. On the basis of that research, positive recommendations could be made to the media (and perhaps enforced in some way) on their presentation of IT in employment.

This section has suggested certain areas of action in which initiatives need to be taken if the supply of personnel at professional level into IT industry is to be anywhere near adequate in the 1990's. At present, by failing to encourage, employ and promote women, that industry is leaving largely untapped half its potential workforce for the future.

DILEMMAS IN VOCATIONAL EDUCATION

The general dilemma for vocational education is simply that vocationalism at one level may be counter-vocational when judged in the overall context of education for employment at all levels. This is one of the strongest single messages emerging from this inquiry.

Instances of that general dilemma in IT have emerged during the inquiry and are discussed below.

The segmented curriculum

Firstly, one of the dangers of vocational education at secondary level is that it could result in a divided or SEGMENTED curriculum at too early an age. This has been seen as one of the dangers of TVEI. If TVEI pupils are to be set aside within a school to follow a "technical and vocational" curriculum are they being segmented from an academic curriculum which may lead to higher education? With certain translations of TVEI into school practice, does it become "the exclusive area for the less able pupil?" (Blackman, 1988). Chitty (1986), for example, argues that "by its implicit operation TVEI will result in the reemergence of the old hard-line tripartite system." (p. 82).

In previous labour markets, of course, such curriculum divisions (although arguably non-egalitarian) may not have mattered greatly since school-leavers were entering employment at a variety of levels from a range of educational backgrounds. But according to the evidence of this inquiry, entry into IT employment is closely related to levels of educational achievement. TVEI pupils, as currently conceived, are unlikely to meet the pressing needs of employers in IT at key levels. This message emerged strongly not only from the employers interviewed (Chapters 9 and 11) but also from the teachers involved in IT courses within TVEI (Chapter 5). The vocational (as opposed to educational) function of information technology courses in TVEI thus needs to be carefully considered. If IT courses for TVEI pupils are not of great vocational value then what purpose do they serve? They do serve an educational function (as I will argue later) and also increase the self-esteem and motivation of pupils taking them (as do ITeC coures: Chapter 6). But, as yet, no evidence exists that TVEI courses in IT are a better preparation for employment, or are more demanded by employers, than other curricula. If, therefore, they take pupils away from another course of education which is ultimately of more value to employers then the TVEI could in fact be counter-vocational. This may well be the case in information technology and employment in the future.

Of course, two factors have yet to be realised or evaluated. Firstly, interpretations of TVEI in schools vary widely (Dale, 1985; Gleeson, 1986; national evaluation: Layton et al). In some schools, TVEI will be more a curriculum innovation (in process and content) than a curriculum option. Following the pipeline analogy, TVEI may well be an ingredient or "colouring" in the pipeline, rather than a new pipeline in itself. Thus segmentation and bi-partitism may be avoided. Secondly, the reaction of higher education to the TVEI has yet to be realised. If TVEI curricula are seen to be acceptable pre-requisites for higher education, then their introduction will not have led to a division of pupils at the age of 14.

Pipelines in Education and Training

The notion of segmentation is related to the second instance of the general dilemma in vocational education. A simple but useful notion in considering education for employment is that of "pipelines". Pipelines into employment occur at several different levels from school-leavers at ages 16 or above, through YTS to diploma, degree and post-graduate level. In certain areas of employment, such as Biotechnology, the pipeline into employment is almost entirely at post-graduate level (Pearson, 1987). In other more traditional areas of employment (such as manufacturing industry) entry has been through a variety of pipelines at different levels. The dilemma for vocational education is that a pipeline branching off from the main stream at one level will reduce the flow at a later level - the analogy with fluid flow in a system of pipes or movement of electrical charges in branching circuits is an easily pictured and straightforward one. If initiatives are taken to create new links (pipelines) with employment at certain levels e.g. TVEI and YTS, what effects will they have on the flow (pipelines) at later levels? The side-effects of central funding of education through specific grants have not been examined or even perhaps anticipated. To pursue the fluid analogy, the creation of new pipelines has not been considered in the overall context of flow into employment generally.

The side-effects of TVEI have already been discussed. A pipeline with perhaps more serious overall effects is the Youth Training Scheme. It may be no coincidence that as YTS expanded in 1982-3, the number of pupils taking A-levels began to fall dramatically (Table 44). To attribute causality to the relationship may be unfounded, but there is surely a connection here which needs further research. This was in fact proposed by an all-party Commons Select Committee on Education in July 1986 (reported in 'Government should monitor initiatives,' TIMES EDUCATIONAL SUPPLEMENT, 4.7.86) but little research has since been done on the side-effects of central funding of new initiatives.

Premature and Deferred Vocationalism

Divisions and segmentation at the ages of 16 and 14 are important factors in taking a holistic view of education for employment. Choices made at these ages are related to class, gender, parental pressure, financial situation, ethnic background - indeed a whole host of interrelated factors (Bates et al, 1984; Brown and Ashton, 1988; Gray, McPherson & Raffe, 1983; Grant, 1987; and many others). The vast literature on choices cannot be explored here but I would like to suggest two notions that may be useful in considering education for employment in IT. They are the notions of DEFERRED VOCATIONALISM and PREMATURE VOCATIONALISM.

Evidence from the above inquiries suggests that many of the pressures to relate education to employment in information technology have led to premature vocationalism. Indeed the whole "hi.tech bandwagon" (Norton-Grubb, 1984) has created strong pressures for premature pipelines to employment which ironically are increasingly inappropriate in the knowledge-intensive IT indutry (Alvey, 1982) of the future. In Norton-Grubb's (1984) analysis of the American situation he points to several tendencies in education and training caused by the "vocational imperative" (p. 450) and, in my terms, premature vocationalism:

> "One tendency is toward exaggeration, over-stating how many high-tech. jobs will be available and overpromising what vocational education can do to solve the country's problems. Such overpromising can lead all too easily to preparing too many students for too few jobs, or to training students too elaborately for jobs that really need little more preparation than brief on-the-job training." (Norton-Grubb, 1984, p. 450)

Both tendencies have been confirmed in the above inquiries into the UK situation. The tendency to overstate the numerical importance of high-tech. jobs has been prevalent in the launch of the Micros. in Schools scheme (Baker, 1981, quoted in Chapter 1), the rhetoric behind

TVEI and YTS (Chapters 1-4), and the stated objectives of the ITeC programme (Chapter 6). The second tendency, i.e. an overstatement of the importance of "IT skills", was also exposed as lacking foundation by the employers' interviews where a commonly expressed theme was that IT skills could be acquired on-the-job in a short time given more fundamental abilities.

A third outcome of premature vocationalism is the tendency towards a narrow skills-based approach to IT training, particularly where this occurs at the expense of basic abilities. This is an obvious danger in the ITeC programme of which many managers are aware (Chapter 6).

The findings of the above inquiries confirm the suspicion discussed in Chapter 3 that a narrow skills-based approach to education is counter-vocational in the "information era". Norton-Grubb supports this view in concluding his analysis of the American situation:

> "...in the high-tech area, the tendency towards specific skills is inappropriate because many students lack the general skills in science and maths that are prerequisites for further learning, and because the pace of change in high tech quickly makes specific skills obsolete". (p. 410-1)

This is perhaps the strongest argument against premature vocationalism. I would speculate that its opposite - deferred vocationalism - is a more fruitful path to follow in the knowledge-intensive era, but that the tendency to follow this path is closely related to financial situation, parental influence and therefore social class. I suggest that education at every level, no matter how apparently irrelevant or unrelated to work at the time, is

ultimately viewed as vocational by parents and students (evidence for this view as far back as 1970 is discussed in Entwistle, 1970). For example, a degree in Classics from Oxbridge is currently far more vocationally valuable than a leaving certificate from an ITeC.
Evidence presented in Chapters 9, 10 and 11 goes some way to supporting the above speculation.

Perhaps the only way to reconcile (or at least postpone) the premature vocationalism at 16 and the deferred vocationalism which still belongs largely to the "middle classes" is to create a unified system of education and training for 16-19 year olds. An interesting proposal along these lines was made by a head teacher in 1984 ('Youth training for all' by John Anderson, TIMES EDUCATIONAL SUPPLEMENT, 5.12.86). All teenagers would join the YTS at the age of 16. They would be paid accordingly. It could be re-named the Youth Education Scheme. A-level courses could be taken alongside (perhaps) CPVE, A/S, and elements of YTS. Entry to higher education would be negotiated accordingly. Anderson's suggestions cannot be examined in detail here but the general notion is worth considering.

Unified provision for all 16-19 year olds, however arranged, would be one way of helping to resolve the dilemmas in vocational education discussed above. Those dilemmas involve the segmentation of the curriculum, the creation and financial support of pipelines into employment with subsequent side-effects, and the conflict between premature and deferred vocationalism.

In essence the dilemma arises because the short-term appeal of vocationalism is hard to resist in a time of high unemployment - however, its long-term consequences for the future of new technology industry may be disastrous. An over-emphasis on the vocational in the school curriculum and a desire to satisfy the immediate "needs of industry" in school and youth training may in the long run prove to be counter-vocational - particularly if the crucial skill shortages continue to exist at the higher levels. Those shortages, and their implications for education and training, are the subject of the next section.

SKILL REQUIREMENTS AND RECRUITMENT STRATEGIES IN INFORMATION TECHNOLOGY

Skill Shortages

The statement of the Alvey Report relating most closely to this inquiry was as follows:

> "Human resources are the key to the advanced information technology programme. Information technology is knowledge intensive and dependent upon skilled manpower." (Alvey, 1982, para 7.1)

All the evidence presented above confirms Alvey's assertion. However, since 1982 inquiries by IMS, NCC, ITSA and other bodies all suggest that the shortages of personnel feared by Alvey (para. 7.11) are now a reality. Forecasts of the future (Connor and Pearson, 1986, for IMS) indicate that IT skill shortages are likely to remain a problem at least into the early 1990's and will continue to hinder the successful development of IT in this country. Such forecasts are regularly being supported by statements in the media on the need for "IT personnel" and the shortage being the "biggest obstacle to the effective use of IT in Britain" (Executive Post, 5.11.87; Computer Weekly, 27.11.87, and many other daily, weekly, and monthly publications).

One of the aims of this inquiry has been to examine the nature of the skill shortages, their level, and to question whether a skills-based approach is appropriate in considering employment needs in a rapidly changing area (Chapters 2 and 3 and subsequently Chapters 8, 9, 10 and 11). This section of Chapter 12 considers those issues in the light of available evidence and their relationship to recruitment strategies in taking people from education and training into employment.

Skill Stratification and Recruitment Strategies

All the evidence presented above suggests that employment in relation to information technology is divided into strata or "segments" (Brown and Ashton, 1988) and that recruitment into these strata is related to levels of education or training. These strata were shown in Table 36 as ranging from graduate level and above, to school-leavers and YTS trainees. The skill requirements for entry into those strata have already been presented and discussed. One important conclusion emerging which is worth re-emphasising concerns the importance of personal qualities or personal attributes. As already shown, such qualities are seen as increasingly important by employers at all levels of recruitment. The value of communication, teamwork, motivation, enthusiasm and the ability to "get on" with others is seen as increasingly important in a technological age. However, in examining employers' selection strategies it is equally clear that personal attributes only operate as selection criteria WITHIN strata. They will not allow a given candidate to TRANSCEND strata i.e. to move from one stratum to another solely by virtue of personal qualities. This seems to be an important principle in employers' recruitment strategies. As suggested earlier, educational achievements are functionally prior to personal qualities in the selection of new staff.

This suggestion perhaps provides a new perspective (from the IT field) on employers' general selection strategies which differs from earlier work by, for example, Ashton and Maguire (1980) and MSC (1977). The 1977 MSC survey asked employers to state the characteristics they thought essential in new recruits. In those statements, attitudinal factors (c.f. my 'personal qualities') were mentioned far more frequently than specific educational qualifications. The reality behind those statements may differ from their face value. My claim is that employers' selection strategies only involve personal qualities once prior qualification and educational achievement requirements have been fulfilled.

In addition, the employment situation has changed rapidly in the decade since the Holland Report, YOUNG PEOPLE AND WORK (MSC, 1977) was published. Table 45 shows the sources of first-time employment for young people in 1976. Those figures, with 35% of young people entering manufacturing industry in 1976, contrast sharply with the analysis of employment patterns given in Chapter 2 above. Dore (1987) talks of a "growingly institutionalised stratification" in today's youth employment market. He implies five levels or strata within that market:

> "At the top are those in further and higher education with little fear of unemployment if they are not too selective about the jobs which they will take. One step down are those in apprenticeships and traineeships and jobs with a promotion future. Then come those who have some other regular job, even dead-end. Then come those on employer-based Youth Training Scheme (YTS) schemes or enrolled in YTS ITeC Centres. And finally come those who are on other Mode B, non-employer-based, YTS schemes - community projects and the like. It is a 'recognised hierarchy', and a unidimensional one, in the sense that there is general agreement that anyone in a lower niche would probably acknowledge his preference for being in a higher one - if only he could have succeeded in the competition to enter it. That perception colours both self-perceptions and employers' perceptions of employee desirability." (Dore, 1987, page 217)

His strata do not coincide exactly with my own suggestions in the field of IT but certainly relate closely. My general point is that strata of this kind are now prominent in employment and the diffusion of information technology may have made them more marked. Their influence is greatest at recruitment and selection stage. This suggestion brings into question the valuable distinction made by Ashton and Maguire in 1980 between five different selection strategies. Those strategies are shown as a continuum in Table 46. In strategy 1, qualifications perform the "determinative" function - at the other extreme, strategy 5, qualifications perform a negative function. My contention is that those strategies have certainly evolved in the field of IT employment, and perhaps more generally. I would suggest that strategy 5 no longer operates in recruitment to jobs involving IT, and strategy 4 is becoming increasingly rare. This may be a symptom of what Ronald Dore calls "the diploma disease" but it exists nonetheless.

Levels, skill-deficits and skill polarisation

The issue of 'stratification' in examining recruitment into employment obviously relates to the skills required of recruits once in employment and the level of skill or expertise needed. The aim of this sub-section is to examine "skill" levels and their evolution, and to begin to relate my own work to the vast literature on the notions of de-skilling and skill-polarisation (from Braverman, 1974, onwards).

The previous section argued that recruitment into IT posts is commonly divided into strata depending primarily on levels of education and training and then secondarily on such attributes as personal qualities within the main strata. Most of the empirical evidence presented above indicates that the key shortages in IT employment occur at graduate level and above. There is little or no evidence that employers have (at present) difficulties in recruiting the school-leavers or youth trainees they require, although it has been pointed out that demographic trends may reduce supply at this level. Thus the key shortages for both IT providers and IT users occur at graduate level and above, particularly graduates with several years of experience in the computer industry. This conclusion is supported by all the research cited so far - from IMS, ITSA, NCC, NEDO and so on.

It seems then that the skills-deficit model of unemployment first introduced in Chapters 2 and 3 (whereby shortages of people with the appropriate skills contribute to unemployment) only operates at ONE level of the strata suggested above i.e. the highest levels. This would seem to be an important message for all those who would wish to blame "skill shortages at every level" (Corelli Barnett, letter to the Times Educational Supplement,20.6.85.) as a root cause of unemployment. As far as IT employment is concerned this suggestion is not supported by either my evidence or the related research studies already cited. It may be the case, as Chapter 2 hinted, that skill-deficits at the highest levels in IT are retarding the growth of IT industry (as Alvey feared) and thereby contributing indirectly to lack of opportunities and reduced employment at LOWER levels. But this is a connection which needs further research.

One of the keys to examining this connection and more generally to speculating on the future of employment strata and "skill" levels lies in the analysis of the employment effects of technological change

(Newton and Leckie, 1987). This is a huge debate which can only be touched upon here - but it is put forward as a suggested line for future research since its implications for future education are so enormous. Fitzgerald (1985) has provided an excellent starting-point from an educationalist's perspective by examining the mathematical abilities needed to use and work with newly introduced technology in a small sample of firms - his work involved detailed ethnographic study of working environments and their implications for mathematics education. A similar study in a very different part of the country was made by Glyn-Jones (1984) in which she examined the computer-related skills at different levels required by employers in Devon. Both studies have important messages for education but employment change has been so rapid (Table 3, Chapter 2 c.f. Table 45) that further studies from an educational perspective are now needed.

In contrast, a vast literature exists from other perspectives on the issue of "de-skilling", skill requirements and technological change. A starting point lies in Braverman's thesis (1974) on the degradation of work in the twentieth century. Braverman argued that technological developments in the twentieth century are gradually bringing about de-skilling across the whole occupational structure. The trend is most marked at lowest levels ("the proletariat") and this brings about a polarisation of skills by creating a small number of highly skilled intellectual and technical jobs (ultimately, even these jobs, he argued, may become de-skilled over time - perhaps Braverman was unwittingly anticipating expert systems and artificial intelligence now so prominent in IT research and development).

Modest support for Braverman's views is provided by some of the evidence in Chapter 8 above - in particular, the retailer who felt that a small, highly educated elite was now creating IT systems for the large numbers literally on the "shop floor" to use. However the same employer felt strongly that only the necessity for extensive "IT skills" was reduced - other abilities and qualities, such as communication, were in greater demand than ever. Similar evidence has been presented above, particularly from IT users in the service sector, and may make a small contribution to this issue.

Braverman's thesis has been recently attacked by Attewell (1987) who, in his review of the de-skilling controversy, concludes that:

> "Contra Braverman, de-skilling has not been the master trend of occupational change in the twentieth century, nor has it proven to be the fate of the proletariat as a whole". (Attewell, 1987, p. 341)

From the manufacturing perspective, Zicklin (1987) in a more detailed empirical study of numerical control machining (NC) in the USA, suggests that there is no simple answer to whether machinists have been de-skilled. He concludes that:

> "...while Braverman deserves much praise for alerting us to the radical potential of microelectronics to transform work, his assertion that the skilled machinist has been "rendered as obsolete as the glassblower"(1974:200) seems more the simplification of ideological thinking than the fruit of careful research." (Zicklin, 1987, p. 463)

The debate on the Braverman thesis will continue and cannot be explored fully here. My main contention is that evolving patterns of work under the influence of technological change have far reaching impications for education and training policy decisions - far more research is needed from an educational perspective into this debate, perhaps along the lines followed by Fitzgerald (1985). If there is any truth in Braverman's general thesis that a highly skilled, technical elite of diminishing size will be required for future work in contrast to an increasingly de-skilled "proletariat" at the other end of the labour market, then how should education respond?

A more recent and perhaps more useful framework for viewing new industrial structures and employment change in the future has been suggested by Rothwell and Zegveld (1985). They show graphically how employment has evolved in advanced industrial societies from largely unskilled, labour intensive to a more value-added, knowledge-intensive structure. The trend is shown in figure 15. They argue that this shift has occurred in Britain and other nations as a result of evolving technology. The Japanese evolution has greatly influenced their education system, an influence analysed by Rothwell and Zegveld (1985, pp. 149-152). In particular, Japan has made a massive investment in engineering education which has created four times as many engineers per head of the population as in the UK. If British industry is indeed undergoing the shift in figure 15 then how should our education and training systems respond? As first discussed in Chapters 2 and 3, there may be important lessons for Britain in Japan's systems provided the vastly different contexts are borne in mind.

These lessons will be examined in a later section in considering broadly the aims of education in "the technological age" (Crowther, 1959). But finally, in this section on skill requirements and the needs of employers at different levels, I would like to re-examine the notion of "IT skills".

"IT Skills"?

The concept of skill and its place in vocational education was first raised in Chapter 3 as a prelude to the empirical inquiries. The question of whether "skills" can be worthwhile as educational objectives, independently of context and without reference to a knowledge base, was then raised. In particular, a question mark was raised over the notion of "information technology skills" as a new category of skill in the 1980's. My contention in the light of the above inquiries is that the notion of "IT skills" as a new set or category in themselves has no foundation, either empirically or conceptually. The notion may have been valuable in the early rhetoric in launching the ITeC programme and other IT initiatives but it has no empirical or conceptual base.

Take the empirical grounds first. No employer in the above inquiry was either willing or able to state requirements in terms of the IT skills needed of recruits. The only SPECIFIC skill mentioned, as summarised earlier, was keyboard skill at all levels. Evidence on this issue is presented in Chapters 8-11 and need not be examined again - its message is unequivocal. Employers are not framing their requirements for staff in terms of "IT skills", but in the language of familiarity, awareness and ability (for example, to learn and adapt).

Empirical work can be a valuable aid in conceptual analysis. (Gilroy, 1983) A conceptual consideration of the notion of information technology skills indicates that the skills of collecting, analysing, interpreting, processing and presenting information remain constant - only the technology has changed. As the retailer in Chapter 8 so succinctly put it, their requirements for staff to receive, handle and interpret information have "not changed in 15 years" - only the technology has evolved.

My argument therefore is that many of the traditional, worthwhile aims of education (including LITERACY and NUMERACY) not only remain unchanged by the advent of new information technology - those aims are made all the more important by IT. Far from displacing the traditional aims of dealing with information and knowledge, the diffusion of IT has conferred upon them greater importance.

Thus, logically speaking, "IT skills" are not a new and separate category or group which have emerged ALONGSIDE literacy and numeracy. They should be seen as a SUBSET of existing worthwhile aims. More importantly for education, information technology should be seen as a way of ENHANCING the traditional, worthwhile aims of education - not as a means of DISPLACING them, let alone making them obsolete. To use a chemical analogy, IT should be seen as a new catalyst not a new ingredient in education AND training. This point is pursued further in the final sections of the chapter.

APPROACHES TO IT EDUCATION AND TRAINING: SKILLS OR "NATIVE ABILITIES"?

The above discussion on IT skills indicates a framework for IT education which can be firmly based on the research evidence and the conceptual analysis preceding it. All the evidence points AWAY from a narrow, skills-based approach to either IT education or training, especially in an employment context of constant change.

My own evidence is supported by many other analysts. A report for the U.S. Department of Education in 1984 on 'vocational computer education' suggested then that "vocational educators may be better advised to teach their students general competencies such as problem-solving and communication skills. The job market is changing so rapidly that specialised vocational curricula may never catch up." (Hunter and Aiken, 1984 and 1987, p. 54)

More recently, Seward-Thompson of the Digital Equipment Company reinforced this message in predicting his company's needs for the future:

> "A crucial change in our own requirements for personnel and their skills is needed for the future. With specific exceptions (such as engineering) we will not need people with specific IT skills. What we WILL need are people who can communicate with our customers, intepreting their needs for the system specifiers, who can educate our customers in the benefits of IT and who can appreciate the role of IT generally in the business world. In short, we will be looking for suitable attitudes and a sound broad-based education, not formal skill-based qualifications." (Seward-Thompson, 1987, p. 25)

His message reinforces my discussion in the previous section and more generally in Chapter 2. The language of skills, so prominent since Callaghan's speech of 1976, may have outlived its usefulness in the technological age. Many other sources could be quoted to support my argument. Two will be given briefly.

Taylor, writing in Worswick (1985), argues that even at graduate level employers are more concerned with 'trainability' than with specific skills. His notion of 'trainability' as an aim of education is related to Ronald Dore's term, 'native abilities':

> "...the increasing sophistication of our technology (and I include our systems for gathering, sorting and evaluating information and processing it into decisions) makes native abilities - learning capacities, trainability - more important". (Dore, 1987, p. 213)

Dore's sentence in parentheses clearly refers to IT. His argument supports my contention that in a context of rapidly evolving information technology a narrow-skills based approach to IT education and training is of no long-term value.

On the basis of these arguments I would like to suggest a framework for viewing vocationalism in the curriculum which has emerged from the above inquiries into IT in education and employment. The approaches shown vary along a continuum from specific skills at one end, through generic skills, to a much broader conception of vocational preparation at the other end of the spectrum (Table 47). The specific skills approach was observed in a small number of Information Technology Centres, particularly those who set out consciously to meet the immediate needs of industry (examples are provided in Chapter 6, in particular the ITeC manager who said during interview that he went out to see what local industry was using, then came back and bought it). A slightly broader approach has been observed in other ITeCs and in schools where the aim was felt to be to develop transferable and generic skills - aims in these terms have also been prevalent in MSC documents of the 1980s

Some of the objections to these two approaches are summarised in Table 47. Problems with a specific skills approach have already been considered in Chapter 3, in employers' interviews and in subsequent discussion. Objections to the aim of developing transferable skills lie largely in the notion of transfer itself. A huge literature exists on the possibility of transfer and transferable skills but they still remain highly problematic notions. Perhaps the two main messages emerging on "transfer" are firstly that it only takes place within closely related domains, and secondly that it needs to be explicitly taught for. Skills are not independent of knowledge, context or values (see Chapters 2 and 3).

My central argument is that vocational education, both in IT and more generally, should be based at the right hand end of the spectrum shown in Table 47. A worthwhile approach to vocational education should involve both the cognitive and affective domains - it will involve knowledge, skills, context and values. It will involve native abilities (Dore, 1987) which include the ability and motivation to learn (the "trainability" of Taylor, 1985). It will involve the psychological well-being and self-esteem of the student which so many of the ITeC managers in Chapter 6 saw as their real goal in youth training and which (Fife-Schaw et al, 1986) is so closely intertwined with computer literacy. It will involve not only competence but awareness, lack of fear and the courage to make mistakes.

This must surely be the correct basis for an approach to IT education and training in the future. This approach reflects in many ways the three identifiable elements within technological literacy suggested by Layton: usage, capability, and awareness. In brief, usage is concerned with developing a knowledge and appreciation of a range of technological 'tools'. Capability involves the identification of a need or a problem which may have a technological solution. While awareness is concerned with encouraging students to think critically about all aspects of technology as it affects the world they live in. These three competencies (explained by Layton in "Current Implications of Technological Literacy") already form the framework for new Technology curricula (for example the GCSE Technology Mode 3 developed under the Sheffield Curriculum Initiative). My view is that they could also be usefully applied to Information Technology education AND training.

A framework in some ways similar is suggested by Bolton (1986) who distinguishes four major stages in the development of technological competence: tool-using, information, reflection, and identification. The first stage involves developing understanding through the use of different tools, instruments and apparatus which involves both knowing-how (Ryle, 1949) and self-expression. The second involves imparting information (knowing-that) in a real context whenever possible. The third and fourth stages involve reflection upon the social and moral implications of technology coupled with an identification of the values inherent in our pursuit of practical knowledge. Bolton argues that this structure should form the basis for a unified approach to technology across the curriculum.

The frameworks of Layton and Bolton provide valuable models in considering the spectrum of approaches to vocational education shown in Table 47. They also provide another perspective, from a wider angle, on information technology education.

Three Eras of IT Education

An additional perspective on IT education is provided by considering the brief history of microcomputing in schools since the 1981 launch of the Micros. in Schools scheme. My contention is that three eras or waves (Sendov, 1986) can be seen in the development of IT education since that time. The term waves or even stages may be preferable since the three eras are not mutually exclusive and, at any given time, different schools or other institutions may be found at different stages. (c.f. Table 10, Chapter 4.) Indeed it could be argued that in view of the evidence of Chapter 5, even parts of the same school may be at different stages or subject to different waves.

In the first wave, computers were introduced into schools (and other institutions) virtually as a new educational facility, almost in the manner of the overhead projector, the tape recorder or the film projector (Sendov, 1986). In many cases they were literally "dropped on school doorsteps" (Steele & Wellington, 1986) courtesy of the Department of Trade and Industry. This virtual parachute drop of a "new innovation" was accompanied by an uncritical wave of enthusiasm from political sources as to its vocational significance:

> "Britain's greatest natural asset has always been the inventive genius of our people. This is the asset which we must tap if we are to profit from advances in technology. In microelectronics and information technology, we must do everything to encourage and train people with the ability, and start in our schools. The microcomputer is the basic tool of information technology. The sooner children become familiar with its enormous potential the better". (Thatcher 1982, p. 1, see also Chapter 4).

At the same time some teachers seized upon IT with almost missionary zeal and rapidly became the 'computer expert' (Lancaster, 1985). This person (commonly male, as Chapter 5 shows) entered a position of considerable influence. His technical knowledge and welcomed commitment (since he was willing to take on the innovation) allowed him to create and manage dependency upon himself (Lancaster, 1985, p. 144). This was coupled with, and perhaps causally related to, the attitude of other teachers whose attitude ranged from calculated ignorance through positive indifference to active hostility to the new appendage to education (caricatures are provided in Ellingham, 1984, and Wellington, 1985a).

Thus, in the first wave, the computer remained very much an appendage to education. As a result, it became an object of study in its own right. The creation of computer rooms and computer experts together with the indifference or hostility of other staff enhanced the rapid growth of Computer Studies documented earlier. A new school subject had emerged in this first era, fuelled by a continued belief in its vocational value.

In the second wave, the value of the computer and more generally IT as an educational resource, begins to be appreciated and developed. In secondary schools the use of the computer spreads into existing disciplines - more and more teachers begin to see it as a valuable educational resource with great potential for their own subject. IT is seen as cross-curricular rather than the province of the expert - students develop the three competencies of Layton above: usage, capability and awareness. The evidence of Chapter 5 suggests that few secondary schools are firmly into the second wave - diffusion has yet to be completed. However, most schools would argue that they are moving towards this position where IT can assist, enhance and develop their teaching of their existing curriculum and the disciplines within it.

The third wave, which is as yet largely hypothetical, occurs when IT influences the CONTENT and the AIMS of education itself, as well as the METHOD and the system of teaching. Sendov (1986) argued that this may occur with the "mass presence of the computer in the social environment". Others argue that it may happen with the advent of powerful computers and information systems (Mackintosh, 1986) and with them, powerful ideas (Papert, 1980). What would occur in a third wave is a re-appraisal of the nature and aims of separate school disciplines in the context of powerful information technology systems and new infrastructures. The progress of IT in both society and education may lead us to examine not only how we teach but what we teach. At first IT may bring into question the nature, aims and content within separate subject areas such as History, Geography, Science and Mathematics. Then, ironically, the diffusion of IT across the existing currriculum (as proposed in the National Curriculum documents of 1987 and 1988) may actually undermine the structure of *that curriculum* and bring into question the wisdom of teaching separate subjects or individual disciplines. This may entail a more "horizontal" view of the whole secondary and tertiary curriculum rather than the existing "vertical" view of the curriculum in terms of discrete subject domains (a point discussed more fully in Wellington, J.J., 1985a).

In summary then, the evolution and influence of IT in education can be viewed in terms of three waves (Table 48). The approaches to IT education discussed in the previous section can be seen alongside that model but not wholly related to it. The changing approach to IT education AND training shown in Table 47 has occurred in relation to the needs of employers in a changing industrial context, whereas the waves of IT in education have largely occurred in the secondary school context.

EDUCATION FOR EMPLOYMENT IN THE INFORMATION AGE

The Education-Employment Relationship

I will argue in this section that the education-employment relationship in the field of IT has been a unique one, and yet the above inquiries can shed some light on the general debate on education for employment.

In many ways the introduction of IT into education has been a totally new and unique experience for the education system as a whole. As Cerych (1985) points out, "the introduction of new information technologies into education is not analogous to past interactions *between education and technology*." The introduction of IT into education has been unique in involving a variety of pressures or influences exerted upon it. Cerych distinguishes three factors as key agencies in the education - IT "interface" (Cerych, 1985, p. 225). He refers to these as 'pedagogical', 'sociological' and 'economic'.

Firstly, IT has entered education as a new pedagogic tool, fundamentally different from tools of the past because it is INTERACTIVE. As a result, IT has been more readily accepted as a tool by learners (and by some teachers) since it can involve active and enjoyable participation. Secondly, the introduction of IT into education has been accompanied by 'sociological pressure' - from parents, from local authorities, from successive Governments, from European and international organisations. This pressure is made evident not least, I would argue, in the funding made available for IT curriculum development and research in the 1980's. Finally, there has been huge economic pressure behind the introduction of new information technology into education because IT is not just an educational tool (as were, for example, the programmed learning machines of an earlier decade). IT is now pervasive in all economic sectors, as the inquiries of Chapters 8-11 make clear. The pressure has come from statements on the "needs of industry", skill shortages, and on the "growing demand for IT skills".

Thus the pressure on IT as an innovation in education has been unique in arising from 3 sources: pedagogic, sociological and economic (Table 49 provides a summary). For this reason, the relationship of education to employment in IT is in some ways a new one. The vocational significance attributed to IT in education in the early eighties (during the first wave) may have abated, but other pressures have sustained its growth. In the second wave suggested above, the value of IT as a pedagogic tool came to the fore and continues to nourish its growth. Similarly, 'sociological' (Cerych, 1985) nourishment of IT as an educational innovation continues strongly with the huge financial support from DES, ESRC, MSC and other bodies made available in the late eighties. Such nutrition (to pursue the metaphor) seems likely to continue into the third wave suggested earlier - and although the economic and vocational pressure on IT education may be more 'realistic' (Table 48) it is unlikely to subside greatly in view of current employment patterns (Parsons, 1985).

Layton (1984) has pointed out that the recurrent debate over education for employment goes back at least to 1887, a theme also raised by Reeder (1979). However, for the reasons discussed above, the position of IT in the debate is a new one. Despite that proviso, I feel that the above inquiries can make some contribution to existing work on the education-employment relationship, and discussions of the 'new vocationalism' (Bates et al, 1984).

Firstly, the themes introduced in the critique of the term 'skills' introduced in Chapter 3 have been reinforced repeatedly in the empirical inquiries following it. I believe that the notion of an "IT skill" as a new category has been a red herring. By talking of "skills" in this context we are using the language of the early and mid- 20th century in attempting to formulate the needs of employers in the late 20th century and the early 21st century - we are making a costly category mistake. As Finn (1987) has pointed out, the notions of "skill needs" and "skill shortages" have received considerable hype. My argument is that this language has clouded the important business of education for employment - it is people who are employed, not skills.

A similar degree of confusion exists in the connections between skill shortages, skill creation, unemployment and employment. It is often argued that skill shortages create unemployment (see Chapter 3). My evidence provides little support for this argument. Even if it were true, does it then follow that skill supplies will CREATE employment? This is surely flawed logic.

All the above inquiries indicate that the relationship between education and employment will remain an extremely complex one. The belief that education and training can create employment has little foundation. In particular, the idea that a concentrated programme of providing people with IT skills will create employment needs to be qualified and analysed. This belief received huge support with the launch of the ITeC programme based on the conviction that training would in a sense create jobs. That programme has now evolved considerably since its inception, with the realisation that the situation is rather more complex.

The education-employment relationship is not a simple supply-demand or producer-consumer connection. It is in some ways a chicken and egg situation. Do the "needs of industry" and skill shortages create demands in the education and training systems? Or does skill creation in those systems improve the employment situation? The relationship surely works both ways - it is a connection which merits far more analysis in view of the importance attached to it from so many quarters. In particular, continuing research is needed into employers' requirements in IT and also the employment effects of developments in vocational curricula. From a more critical stance, research is also needed into the way in which employers' demands may be used or even distorted by certain groups (perhaps for political reasons) in order to promote a particular educational viewpoint. The interpretation and exploitation of employers' requirements is a complex process involving values as well as facts.

Other notions in the education for employment debate on which this inquiry throws some light are the very notions of the 'needs of industry', 'the needs of employers' and the 'needs of society'. The problematic nature of these ideas has been examined, largely from a philosophical perspective, by Beck (1981), Edgeley (1977), Jonathan (1983), Reeder (1979), Moore (1987) and others. My own inquiries suggest that the belief that education should meet the "needs of industry" is of no more value than suggesting that it should be relevant. The statement has no descriptive meaning - it is little more than an emotive plea. Any empirical attempt to give concrete meaning to such phrases as "the needs of industry" or "skills for the future" is doomed to failure.

How far, then, should a slightly different notion, the "needs of employers", determine the school curriculum? What should be the aims of education in the "information age"?

The Curriculum and the Needs of Employers

One point, which makes economic as well as educational sense given the rapidly changing patterns of employment discussed earlier, was first made by Dewey over 70 years ago:

> "Any scheme for vocational education which takes its point of departure from the industrial regime that now exists is likely to assume and to perpetuate its divisions and weaknesses, and thus to become an instrument in accomplishing the feudal dogma of social predestination ... To split the system, and give to others, less fortunately situated, an education conceived mainly as specific trade preparation is to treat the schools as an agency for transferring the older division of labour and leisure, culture and service, mind and body, directed and directive class, into a society nominally democratic." (Dewey, 1916)

This oft-quoted passage from Dewey makes even more sense in the 1980's. For the school curriculum to attempt to meet the "needs of employers" in any SPECIFIC sense would be both foolish and divisive.

Firstly, the sheer rapidity of change in employment patterns will make any specifically stated needs of employers obsolete in a very short time. This point is revealed not only by examining data on employment (Chapter 2 and related references) but also by the empirical inquiries into employers' needs. The numerous statements from employers presented above make it clear that specific vocational preparation is not seen as a sensible aim for education from the employers' perspective. However, GENERAL messages on employers' needs and requirements have emerged and I will argue shortly how these should influence education.

Secondly, a curriculum aimed solely at existing employment patterns and needs will be a divisive one if interpreted rigidly. This is perhaps Dewey's main point. To "split the system" so that one group are given "specific trade preparation" (Dewey) would be to create the segmentation and premature vocationalism discussed earlier. It would be a retrograde step for both education and employment if the curriculum of the future were to be the victim of a crude and narrow form of vocationalism.

My contention is that the curriculum of ALL pupils should contain three elements: content, process and context. None of these elements should be over-emphasised at the expense of another. Content will involve knowledge of different kinds, including both knowledge that and knowledge how (Ryle,1949). Process will involve the skills and processes in education generally, and present in the various forms of knowledge and thought, but these processes will be intimately related to knowledge. Finally, the curriculum should involve the context in which it is located. This will necessitate a consideration of the "needs of employers", changes in society, evolving employment patterns and the purpose of education in technological age. The curriculum of the future should attempt to balance these three vital facets. One of the achievements of the vocationalism set in motion by Callaghan in 1976 has been to improve the emphasis on context as a curriculum element - my argument is that this should not be taken too far or interpreted too narrowly.

The Aims of Education in a Technological Age

The Crowther report of 1959 spoke of the "task of education in the technological age" as being a double one. To some extent that dual task still holds, although my final argument will be that the two roles are increasingly converging:

> "The task of education in the technological age is thus a double one. On the one hand, there is a duty to set young people on the road to acquiring the bewildering variety of qualifications they will need to earn their living. On the other hand, running through and across these vocational purposes, there is also a duty to remember those other objectives of any education, which have little or nothing to do with vocation, but are concerned with the development of human personality and with teaching the individual to see himself in due proportion to the world in which he has been set." (Crowther Report, 1959, p. 53)

In the thirty years which have passed since Crowther's report we have moved some way towards the post-industrial society (Bell, 1974). Bell envisaged that the production of goods would require a decreasing labour force, while growth in employment would be mainly in the "service areas". At the same time the "post-industrial state" would be increasingly technocratic, with skills and education replacing birth and property as the basis of political power. Evidence considered in earlier chapters supports at least part of Bell's thesis, particularly his view of a "technocracy" gaining importance in the information era.

Bell's predictions, midway between Crowther and the present time, are being realised but change is still rapid and continuing. The adage that "Constant change is here to stay" holds good. This remains the most important message for education in the technological age. Education must prepare people for change. Whiston, Senker and Macdonald made this point in 1980 in collating available evidence on technological change and its influence on education:

> "One of the problems with any study of the consequences of technical change for the training and educational requirements of jobs is that such studies have to operate to some extent in a static framework. It is quite conceivable that much employment in jobs requiring very high levels of education is related not to the particular state of technology at the time, but to its rate of change. Many highly trained and educated people may be needed to change the design of products, processes and organisations in an environment of rapid technological change. This applies not least to education itself, in which the teachers require constant re-education in order to equip themselves and their pupils for work and leisure in a changing world." (Whiston et al, 1980)

The rapidity of change (as argued ealier) makes any statement of specific skill requirements, and a narrow skills-based approach to education or training, totally obsolete. This point, and that of Whiston et al, was reinforced by many of the statements by employers documented earlier. One of these statements is particularly apt and worth repeating in these concluding remarks:

> "The rate of change of technology means that training should be based not on the understanding of a specific technology but on the ability to assimilate and gain an understanding of new technology as it appears". (employer, Division 3)

This discussion provides important pointers to the central question: what should be the aims of education in a technological age? Certainly they should include the ability to assimilate new knowledge and "new technology as it appears". This encompasses Taylor's (1985) notion of trainability and Dore's (1987) native abilities discussed earlier. A 'specific skills' approach to education and training (Table 46) will constrain this aim, a point supported by Taylor:

> "Ill-considered vocational specificity in schooling can produce training in capacity that reduces rather than enhances, employability." (Taylor, 1985, p. 107).

The evidence points increasingly to vocational preparation away from the specific skills end of the continuum in Table 47 and towards an emphasis at the other end of the spectrum - an emphasis on the ability to learn, on motivation, on technological literacy. Evidence from employers throughout this inquiry has supported that broad approach to vocational preparation. The needs of employers are increasingly stated in such terms as motivation, willingness, awareness, ability to learn, communication, confidence and co-operative working - in short, a broad-based education involving literacy and numeracy with a growing emphasis on personal qualities.

Supporting evidence from the USA for an increasing convergence between the goals of vocational preparation and of personal development is presented by Chickering (1986) in summarising the work of George Klemp. Klemp and his research team identified successful individuals working in a variety of settings: civil service, small businesses, military, counselling, sales and so on. They examined the qualities which made them successful in their own role. Klemp consistently found three general abilities or characteristics. General cognitive abilities or skills were the first common factor: the ability to acquire and use knowledge. Secondly, they noticed that interpersonal skills contributed in all cases to success at work: communication, fluency, empathy and responsiveness. The third critical factor was motivation - without this characteristic cognitive and interpersonal abilities would lack effectiveness.

Now Klemp's study may not apply to ALL the jobs which young people will acquire in a technological age - to expect this might be to expect too much of future employment. But, as educational goals they relate closely to the goals of liberal education and the education of the individual. If vocational and technological education are correctly conceived then their aims should coincide with those of a so-called liberal education:

> "The antithesis between a technical and a liberal education is fallacious. There can be no adequate technical education which is not liberal, and no liberal education which is not technical; that is no education which does not impart both technique and intellectual vision." (A.N. Whitehead speaking in 1929, quoted by Marchello, 1987)

My final conclusion therefore is that IT should be used to ENHANCE the worthwhile aims of education which will remain unchanged in a technological age:

> "No matter how society changes, we must continue to train young people to speak and write clearly, to manipulate mathematical and logical concepts, to be familiar with history, literature and cultures, and to have an *understanding of the world*. The basic definition of an educated person will remain relatively stable." (Marchello, 1987, p. 565)

In a context of continuing change the aims central to a broad-based, liberal education must remain constant. They must not be diverted by premature vocationalism, or by divisive curricula. They will be enhanced by the diffusion of information technology throughout education at all levels, by greater attention to equal opportunities and by a coherent, unified pattern of provision for the 16-19 age group. Only along these lines will industry of the future be supplied with the personnel it needs at all levels. I present to the reader the evidence of the above inquiry as support for this conclusion.

POSTSCRIPT: PROBLEMS OF SAMPLING AND GENERALISING

In a large and rapidly changing field any piece of research is faced with the problem of limiting its own scope (i.e. in making decisions on sampling) and of drawing conclusions from its findings in the face of continuing change. This inquiry has been no exception and the following sections are included in orderto place the study in a broader perspective. The issues are considered under two headings: firstly, the empirical base and secondly, recent developments, including the evolution of the language itself used in this context.

The Empirical Base

It is worth re-emphasising at this concluding stage that the empirical base on which the concluding chapter above is partly based has certain obvious weaknesses, both in breadth and depth.

Firstly, the school survey was dependent on the state of the electronic network used (the Times Network System) at that time. The low response rate already noted may have been partly caused by the novelty of the network and its lack of use across the school curriculum. That situation will have changed dramatically in recent months with increasing development of IT across the curriculum, growing familiarity with communication systems in schools, and the increasingly tangible effects of in-service initiatives such as TRIST. Indeed it would be interesting and very revealing to carry out an electronic survey in the near future to see how response rates and approaches to IT across the curriculum had changed in the relatively short period of (say) three years. An interesting question to investigate then would be the issue of how far these developments were related to in-service programmes such as TRIST.

Secondly, it must be stressed(as Chapter 6 indicated) that the empirical survey above did not include 16-19 practice in further education (NAFE). A large number of important initiatives have taken place in this area in recent years which, due to the inevitable limitations placed upon the above inquiry in terms of scope, have not been investigated. It became clear, partly through the employers' survey, that many initiatives in information technology in further education were meeting the needs of employers at certain levels. This is an area which merits further investigation, paticularly in view of the comments of certain employers in the case studies on the misuse of graduates and the position of the "technician" in the future. The relationship of NAFE to the changing requirements of employers in information technology has not been covered in this study but is surely a vital issue for further research.

Finally, the postal survey of employers has the limitations pointed out in Chapter 10 which will in turn have influenced the concluding remarks in Chapter 12. Three weaknesses in particular are worth re- emphasising. Firstly, the labour market before , during and after the survey has undergone rapid change which has been enhanced by IT itself. Secondly, existing classifications of "industrial sectors"(such as SIC) seem increasingly inappropriate in the face of such change. Future inquiries of this kind would be well advised to consider other ways of classifying employment if they become readily available and if it is practical to use them when going through the very real task of compiling a mailing list. Thirdly, the postal survey of employers was biassed against the smaller employer, of which there must be huge numbers involved in both providing and using IT. This must be considered a serious omission in the above study. A future research project in this field might well consider ONLY the smaller employers and their needs with respect to information technology.

Recent Developments

Inevitably, a research undertaking in such a rapidly changing field can only provide, in a sense, a snapshot of events over a period of time. That picture can however be valuable paricularly if it attempts to make generalisations and suggest hypotheses which can be judged by future research.

Recent developments in education and training, and in the language used to describe it, necessitate that the above discussion be viewed from a continually new and constantly changing perspective. In-service education, first discussed in the interviews with teachers in Chapter 5, has undoubtedly had an effect. The effects of TRIST for example, particularly in promoting the use of IT across the curriculum, are visibly filtering (or cascading?) through the school system. Many schools are now experiencing the "third wave " of IT in secondary education suggested in Table 48.

Other changes have created greater coherence and unification in the 16-19 sector which may in future make a mockery of the" islands of education" metaphor used in Chapter 4. The move towards a unified system of education and training for 16-19 year olds appears to be gaining momentum, particularly in areas where tertiary provision is being systematically developed. If such development can be related to changing employment patterns in those areas then many of the criticisms reported in the above inquiry(from both employers and educationists) may become less common in the future.

Finally, the language of "vocational education" - first examined in Chapter Three - has evolved with recent developments such as the Enterprise in Higher Education Initiative(EHEI) and the ongoing discussions of the National Council for Educational Qualifications (NCVQ), first established in October 1986. The brief of the latter was to develop (by 1991) a framework of qualifications reflecting "employment-led standards of competence". Thus the language of competences may be more prevalent in the future than the language of skills, a change which is also reflected in the planning and development of the Training Agency. Whatever the language of vocational education for the future, it will require the same kind of critical analysis as it has received in the past.

BIBLIOGRAPHY

ACARD (1986), SOFTWARE: A VITAL KEY TO UK COMPETITIVENESS (LONDON: ACARD).

Aleksander, I. (1986), "Information Technology and the Management of Change", JOURNAL OF INFORMATION TECHNOLOGY, Vol. 1, no. 1. pp.7-13 (Kogan Page).

Alvey Committee (1982), A PROGRAMME FOR ADVANCED INFORMATION TECHNOLOGY (London: HMSO).

Angell, C. (1987), INFORMATION, NEW TECHNOLOGY AND MANPOWER (Boston Spa: British Library).

Ashton D. and Maguire, M. (1980), "The Function of Academic and Non-Academic Criteria in Employers' Selection Strategies" in BRITISH JOURNAL OF GUIDANCE AND COUNSELLING, July 1980.

Atkinson, J. (1968), THE GOVERNMENT SOCIAL SURVEY - A HANDBOOK FOR INTERVIEWERS (London: HMSO).

Attewell, P. (1987), "The Deskilling Controversy", WORK AND OCCUPATIONS, Vol. 14, no. 3, pp.323-346.

Aylett, R. (1986), WOMEN AND COMPUTING IN SHEFFIELD CITY POLYTECHNIC (unpublished paper, Sheffield City Polytechnic).

Bailey, C. (1984), BEYOND THE PRESENT AND PARTICULAR: A THEORY OF LIBERAL EDUCATION, particularly Chapter 9 (London: Routledge and Kegan Paul).

Bailey, P. (1986), "Computer Literacy: notions, courses and perceptions," unpublished M.Ed. thesis, University of Sheffield.

Ball, Colin and Mog (1979), FIT FOR WORK? YOUTH, SCHOOL, AND (UN)EMPLOYMENT (London: Chameleon Books).

Barrow, R. (1981), THE PHILOSOPHY OF SCHOOLING (Wheatsheaf Books).

Bates, I. et al (1984), SCHOOLING FOR THE DOLE?: THE NEW VOCATIONALISM (London: Macmillan).

Beck, J. (1981), "Education, Industry and the Needs of the Economy" in CAMBRIDGE JOURNAL OF EDUCATION, Vol. 11, part 2, pp.87-106.

Bell, J. (1987), DOING YOUR RESEARCH PROJECT (Milton Keynes: Open University Press).

Berg, I. (1970), EDUCATION AND JOBS: THE GREAT TRAINING ROBBERY (Penguin Books).

Bishop, P. (1986), 'Travails in the Shires', ED-IT WORLD, June/July 1985, pp.4-5.

Blaazer, C. (1988), "The top jobs that are just waiting for the right women", THE TIMES, 7.1.88.

Blackman, S. (1987), "The Labour Market in School: New Vocationalism and Issues of Socially Attributed Discrimination" in Brown, P. and Ashton, D. (eds.) (1987), pp.27-57.

Bleach, P. (1986), COMPUTER USE IN PRIMARY EDUCATION (University of Reading).

Bogdan, R. and Biklen, S. (1982), QUALITATIVE RESEARCH FOR EDUCATION (Boston: Allyn and Bacon).

Bolton, N. (1986), TECHNOLOGY ACROSS THE CURRICULUM (unpublished paper, University of Sheffield).

Bradshaw, D. (1985), "Transferable Intellectual and Personal Skills", in OXFORD REVIEW OF EDUCATION, VOL.11, No. 2, pp.201-216.

Braun, E. and Senker, P. (1982), NEW TECHNOLOGY AND EMPLOYMENT (London: MSC).

Braverman, H. (1974), LABOUR AND MONOPOLY CAPITAL: THE DEGRADATION OF WORK IN THE TWENTIETH CENTURY (New York: Monthly Review Press).

Breakwell, G., Fife-Schaw, C., Lee, T. (1985), "Survey of student attitudes to technology", SCIENCE AND PUBLIC POLICY (vol. 12, no. 6, pp.337-340).

Breakwell, G. et al (1986), "Attitudes to New Technology in relation to social beliefs and group memberships", CURRENT PSYCHOLOGICAL RESEARCH AND REVIEWS (Spring 1986, pp.34-47).

Breakwell, G. et al (1987), "Occupational Aspirations and attitudes to new Technology", JOURNAL OF OCCUPATIONAL PSYCHOLOGY (60, pp.169-172).

Brenner, M., Brown, J. and Canter, D. (ed.) (1985), THE RESEARCH INTERVIEW: USES AND APPROACHES (LONDON: ACADEMIC PRESS).

Brown, P. and Ashton, D. (eds) (1987), EDUCATION, UNEMPLOYMENT AND LABOUR MARKETS (Brighton: Falmer Press).

Buckroyd, B. and Cornford, D. (1988), THE IT SKILLS CRISIS - THE WAY AHEAD (Manchester: NCC).

Burgess, R.G. (1984), IN THE FIELD: AN INTRODUCTION TO FIELD RESEARCH, (London: George Allen and Unwin).

Burgess, R.G. (ed.) (1985a) STRATEGIES OF EDUCATIONAL RESEARCH: QUALITATIVE METHODS (Falmer Press).

Burgess, R.G. (ed.) (1985b) FIELD METHODS IN THE STUDY OF EDUCATION (Falmer Press).

Burstyn, J. (ed.) (1986), PREPARATION FOR LIFE? THE PARADOX OF EDUCATION IN THE LATE TWENTIETH CENTURY (Falmer Press).

Campbell, A. and Warner, M. (1987), "New Technology, innovation and training", in NEW TECHNOLOGY, WORK AND EMPLOYMENT (Autumn 1987, 2(2), pp.86-98).

Capra, F. (1983), THE TAO OF PHYSICS, (London: Fontana).

Central Policy Review Staff (1980), EDUCATION, TRAINING and INDUSTRIAL PERFORMANCE (London: HMSO).

Central Services Unit (1985), THE SUPPLY OF UNIVERSITY GRADUATES 1985-1987: TRENDS AND PREDICTIONS (C.S.U.).

Cerych, L. (1985), "Problems Arising from the use of new technologies in education", EUROPEAN JOURNAL OF EDUCATION (Vol. 20, nos. 2-3, 1985).

Chalmers, A.F. (1982), WHAT IS THIS THING CALLED SCIENCE? (Milton Keynes: Open University Press).

Chapman, B. (1986), "Reflections on 'In Place of Confusion", in SCHOOL SCIENCE REVIEW, December 1986, p.363.

Chickering, A. (1986), "The modern American College: integrating liberal education, work and human development", in Burstyn, J. (ed.) (1986).

Chitty, C. (1987), "TVEI: The MSC's trojan horse", in Benn, C. and Fairley, J. (eds.) CHALLENGING THE MSC (London: Pluto Press), pp.76-98.

Cohen, L. and Manion, L. (1986), RESEARCH METHODS IN EDUCATION (London: Croom Helm), 2nd edition.

Cohen, P. (1985), "Against the New Vocationalism", in Bates. I. et al (1985).

Connor, H. (1985), THE DESTINATIONS OF 1984 IT POSTGRADUATE STUDENTS (Brighton: IMS).

Connor, H. and Pearson, R. (1986) INFORMATION TECHNOLOGY MANPOWER INTO THE 1990S (Brighton: IMS).

Cornford, D. (1987), INFORMATION TECHNOLOGY TRENDS: THE REPORT OF THE 1986 SURVEY OF USER ORGANISATIONS (Manchester: NCC, The National Centre for Information Technology).

Council for Educational Technology (1978), MICROELECTRONICS: THEIR IMPLICATIONS FOR EDUCATION AND TRAINING (London: CET).

Crowther Report (1959), 15-18: A REPORT OF THE CENTRAL ADVISORY COUNCIL FOR EDUCATION (London: HMSO).

CSE Microelectronics Group (1980) MICROELECTRONICS: CAPITALIST TECHNOLOGY AND THE WORKING CLASS (Conference of Socialist Economists: London).

Dain, J. (1988), GETTING WOMEN INTO COMPUTING (Research Report no. 116, Dept. of Computer Science: University of Warwick).

Dale, R. (ed.) (1985), EDUCATION, TRAINING AND EMPLOYMENT; TOWARDS A NEW VOCATIONALISM? (The Open University: Pergamon Press).

Dean, J.P. and Whyte, W. (1969), "How do you know if the informant is telling the truth?" in McCall, G. and Simmons, J. (eds.) ISSUES IN PARTICIPANT OBSERVATION (Reading, Mass: Addison-Wesley).

Dearden, R.F. (1985), "Education and Training", in WESTMINSTER STUDIES IN EDUCATION, Vol.7, 1984, pp.57-66.

Deloite, Haskins and Sells (1984), A REVIEW OF THE INFORMATION TECHNOLOGY CENTRE (ITeC) PROGRAMME (Manpower Services Commission).

Denzin, N. (1970), THE RESEARCH ACT (Chicago: Aldine).

Department of Education and Science (1985) INFORMATION TECHNOLOGY INITIATIVE IN THE PUBLIC SECTOR OF HIGHER EDUCATION (Report by HMI) (London: DES).

Department of Education and Science (1986), STATISTICAL BULLETIN, 18/86: RESULTS OF THE SURVEY OF MICROCOMPUTERS IN SCHOOLS (London: DES).

Department of Education and Science (1987), ASPECTS OF THE WORK OF THE MEP (London: DES).

Department of Employment/DES (1986), WORKING TOGETHER-EDUCATION AND TRAINING (London: HMSO).

DES/Welsh Office (1987), THE NATIONAL CURRICULUM 5-16: A CONSULTATION DOCUMENT (London: DES).

Department of Trade and Industry (1985) IT SKILLS SHORTAGES COMMITTEE: FIRST REPORT - THE HUMAN FACTOR - THE SUPPLY SIDE PROBLEM.

Department of Trade and Industry (1985), SECOND REPORT - CHANGING TECHNOLOGY - CHANGING SKILLS: SHORTAGES AT TECHNICIAN LEVEL.

Department of Trade and Industry (1985), FINAL REPORT - SIGNPOSTS FOR THE FUTURE.

Dertouzos, M. and Moses, J. (eds.) (1979), THE COMPUTER AGE: A TWENTY-YEAR VIEW (Cambridge, Mass.: MIT Press).

Dewey, J. (1916), Democracy and Education (New York: Macmillan).

Dickey, J.W. and Watts, T. (1978), ANALYTIC TECHNIQUES IN URBAN AND REGIONAL PLANNING (New York: McGraw Hill).

Dore, R. (1987), "Citizenship and Employment in an age of high technology", BRITISH JOURNAL OF INDUSTRIAL RELATIONS (25, 2, pp.201-226).

Dutton, P. et al (1984), ALL CHANGE (National Extension College/M.E.P.).

Eaton, J. and Smithers, J. (1982), THIS IS IT: A MANAGERS GUIDE TO INFORMATION TECHNOLOGY (Philip Allan).

Edgley, R. (1977) "Education for Industry" in EDUCATIONAL RESEARCH, Vol. 20 No. 1., pp.26-32.

Edmondson, W. (ed.) (1985): THE AGE OF ACCESS: INFORMATION TECHNOLOGY AND REVOLUTION - THE POSTHUMOUS PAPERS OF COLIN CHERRY (Croom Helm).

EEC (1986), SOCIAL EUROPE: NEW TECHNOLOGY AND SOCIAL CHANGE - MANUFACTURING AUTOMATION (Luxembourg: Commission of the European Communities, 1986).

Ellam, N. and Wellington, J.J. (1986), COMPUTERS IN THE PRIMARY CURRICULUM (University of Sheffield).

Ennals, R. and Cotterell, A. (1985), FIFTH GENERATION COMPUTERS: THEIR IMPLICATIONS FOR FURTHER EDUCATION (Further Education Unit).

Entwistle, H. (1970) EDUCATION, WORK AND LEISURE (London: Routledge & Kegan Paul).

Evans, A. and Hall, W. (1987), "Programming Inequality", TIMES EDUCATIONAL SUPPLEMENT (2.10.87, p.4).

Evans, N. (1986), THE FUTURE OF THE MICROCOMPUTER IN SCHOOLS (Macmillan Education).

Faraday, A. and Plummer, K. (1979, "Doing Life Histories", Sociological Review, 27, 4.

Faulkner, R. (1982), "Improvising on a triad", in van Maanen J. et al, VARIETIES OF QUALITATIVE RESEARCH (California: Sage) pp.65-102.

Fetterman, D.M., (ed.) (1984), ETHNOGRAPHY IN EDUCATIONAL EVALUATION (California: SAGE).

Fetterman, D.M. (1984),"Guilty Knowledge, Dirty Hands and Other Ethical Dilemmas", in Fetterman (ed.) (1984).

Fiddy, R. (1985), YOUTH UNEMPLOYMENT AND TRAINING (Falmer Press).

Fiddy, R. (1986), "Education for Employment and Unemployment: Is this The Age of The Trained?" in Wellington, J.J. CONTROVERSIAL ISSUES IN THE CURRICULUM (Oxford: Basil Blackwell).

Fife-Schaw, C., Breakwell, G. et al (1986), "Patterns of teenage computer usage", JOURNAL OF COMPUTER ASSISTED LEARNING (2, pp.152-161).

Finn, D. (1987), TRAINING WITHOUT JOBS: NEW DEALS AND BROKEN PROMISES (Basingstoke: Macmillan).

Firestone, W. and Herriott, R. (1984), 'Multisite Qualitative Policy Research' in Fetterman, D. (ed)., ETHNOGRAPHY IN EDUCATIONAL EVALUATION (California: Sage).

Fitzgerald, A. (1985), NEW TECHNOLOGY AND MATHEMATICS IN EMPLOYMENT (University of Birmingham).

Forrester, T. (1985) THE INFORMATION TECHNOLOGY REVOLUTION - THE COMPLETE GUIDE (Oxford: Basil Blackwell).

Fowles, J. (1976), "An overview of social forecasting procedures", JOUR A.I.P., 42, pp.253-263.

Garland, R. (ed.) (1982), MICROCOMPUTERS AND CHILDREN IN THE PRIMARY SCHOOL (Lewes: Falmer Press).

Gershuny, J.I. (1978), AFTER INDUSTRIAL SOCIETY?: THE EMERGING SELF-SERVICE ECONOMY, (London: Macmillan).

Gershuny, J.I. and MIles, I.D. (1983), THE NEW SERVICE ECONOMY: THE TRANSFORMATION OF EMPLOYMENT IN INDUSTRIAL SOCIETIES (London: Francis Pinter).

Gilbert, L.A. (1985), THE DISTRIBUTION OF MICROCOMPUTER SOFTWARE TO EDUCATION (Council for Educational Technology).

Gill, C. (1985) WORK, UNEMPLOYMENT AND THE NEW TECHNOLOGY (Cambridge: Polity Press/Basil Blackwell).

Gilroy, P. (1983), "The empirical researcher as philosopher", in BRITISH JOURNAL OF TEACHER EDUCATION, Vol.6, No.3, pp.237-250.

Glaser, B. and Strauss, A. (1967), THE DISCOVERY OF GROUNDED THEORY (London: Weidenfeld and Nicholson).

Gleeson, D. (ed.) (1987), TVEI AND SECONDARY EDUCATION: A CRITICAL APPRAISAL (Milton Keynes: Open University Press).

Glyn-Jones, A. (1984), JOB SKILLS IN THE COMPUTER AGE (Devon County Council and The University of Exeter).

Gordon, A. (1986), "Education and training for information technology", STUDIES IN HIGHER EDUCATION (11, 2, pp.189-198).

Grant, P. (1987), YOUTH EMPLOYMENT AND TECHNOLOGICAL CHANGE (Aldershot: Gower).

Gray, J., McPherson, A.F. and Raffe, D. (1983), RECONSTRUCTIONS OF SECONDARY EDUCATION (London: Routledge & Kegan Paul).

Green, H. (1987), "Matching people to jobs: an expert system approach", in PERSONNEL MANAGEMENT (September 1987, pp.42-3).

Griffin, C. (1985), TYPICAL GIRLS? YOUNG WOMEN FROM SCHOOL TO THE JOB MARKET (London: Routledge and Kegan Paul).

Hagger, E. (1984), LIKELY TRENDS IN GRADUATE EMPLOYMENT (Association of Graduate Careers Advisory Service).

Halsey, A., Floud, J. and Anderson, C. (eds.) (1961), EDUCATION, ECONOMY AND SOCIETY (New York: Free Press).

Hammersley, M. (1987), "Some notes on the terms 'Validity' and 'reliability'", in BRITISH EDUCATIONAL RESEARCH JOURNAL, Vol. 13, no.1, 1987.

Hammersley, M. and Atkinson, P. (1983) ETHNOGRAPHY: PRINCIPLES IN PRACTICE (Tavistock Publications).

Handy, C. (1985), THE FUTURE OF WORK (Oxford: Basil Blackwell)

Hart, W.A. (1978), "Against Skills" in OXFORD REVIEW OF EDUCATION, Vol.4, No.2, pp.205-216.

Harris, D. (ed.) (1988), EDUCATION FOR THE NEW TECHNIQUES (London: Kogan Page).

Haughton, E. (1987), "Whatever happens to the working women?, COMPUTER WEEKLY (15.19.87).

Hayes, C., Fonda, N., Pope, M., Stuart, R. and Townsend, K. (1983) TRAINING FOR SKILL OWNERSHIP: LEARNING TO TAKE IT WITH YOU, IMS Report No. 68 (Beighton: IMS).

Henize, J. (1981), "Evaluating the employment impact of information technology", TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE (20, pp.41-61).

Her Majesty's Stationery Office (1985), THE DEVELOPMENT OF HIGHER EDUCATION INTO THE 1990s (London: HMSO).

Herriot, P. (1987), "Graduate recruitment - getting it right", EMPLOYMENT GAZETTE (February 1987, pp.78-83).

Hills, P.J. (ed.) (1982), TRENDS IN INFORMATION TRANSFER (London: Frances Pinter).

Holdoway, S. (1985), INSIDE THE POLICE FORCE (Oxford: Basil Blackwell).

Holmes, P. and Worsnop, R. (1985), STATISTICAL NEEDS OF NON-SPECIALIST YOUNG WORKERS (Centre for Statistical Education).

Holt, M. (1983), "Vocationalism: the new threat to universal education", in FORUM, Summer 1983.

Holt, M. (ed.) (1987), SKILLS AND VOCATIONALISM: THE EASY ANSWER (Milton Keynes: Open University Press).

House of Lords Select Committee on Science and Technology (1984), EDUCATION AND TRAINING FOR NEW TECHNOLOGIES (London: HMSO).

Hunter, B. and Aiken P. "The evolution of computer courses in vocational education", TECHNOLOGICAL HORIZONS IN EDUCATION (vol. 14, part 7, pp.54-57).

Huws, U. (1982), NEW TECHNOLOGY AND WOMEN'S EMPLOYMENT (Equal Opportunities Commission).

Huxley A. (1938), ENDS AND MEANS (London: Chatto and Windus).
Industrial Market Research Ltd. (1985) THE DESIGN NEEDS OF INDUSTRY (BTEC).

Information Technology Advisory Panel (1986), LEARNING TO LIVE WITH IT: AN OVERVIEW OF THE POTENTIAL OF INFORMATION TECHNOLOGY FOR EDUCATION AND TRAINING (London: HMSO).

Institute of Manpower Studies (1986a) GRADUATE SUPPLY AND AVAILABILITY TO 1987 AND BEYOND (Brighton: Institute of Manpower Studies).

Institute of Manpower Studies (1986b), UK OCCUPATION AND EMPLOYMENT TRENDS TO 1990 (Brighton: Institute of Manpower Studies).

Jackson, M.P. (1985), YOUTH UNEMPLOYMENT (Croom Helm).

Jahoda, M. (1983), EMPLOYMENT AND UNEMPLOYMENT: A SOCIAL-PSYCHOLOGICAL ANALYSIS (Cambridge: Cambridge University Press).

Jenkins, C. and Sherman, B. (1979), THE COLLAPSE OF WORK (London: Eyre Methuen Ltd.).

Jenkins, R. (1986), RACISM AND RECRUITMENT (Cambridge University Press)

Jonathan, R. (1983), "The manpower service model of education", in CAMBRIDGE JOURNAL OF EDUCATION, Vol. 13, No. 2, 1983, p.9.

Jonathan, R. (1985), 'Education, Philosophy of Education and Context', in JOURNAL OF PHILOSOPHY OF EDUCATION, Vol.19, No.1, pp.13-25.

Jones, T. (ed.) (1980) MICROELECTRONICS AND SOCIETY (Open University Press).

KBE (1984, 1985, 1986, 1987), KEY BRITISH ENTERPRISES: THE TOP 20,000 BRITISH COMPANIES (London: Dun and Bradstreet Ltd.) Volumes 1 and 2.

Kogan Page, (1985), DIRECTORY OF OPPORTUNITIES IN NEW TECHNOLOGY (London: Kogan Page).

Kuhn, T.S. (1970), THE STRUCTURE OF SCIENTIFIC REVOLUTIONS (Chicago: Chicago University Press).

Kumar, K. (1978), PROPHECY AND PROGRESS: THE SOCIOLOGY OF INDUSTRIAL AND POST-INDUSTRIAL SOCIETY, (London: Allen Lane).

Lancaster, D. (1985), "The Response to and impact of, Information Technology in schools and colleges: the key individuals", EDUCATIONAL MANAGEMENT AND ADMINISTRATION (13, pp.140-145).

Law, B. (1986), THE PRE-VOCATIONAL FRANCHISE: ORGANIZING COMMUNITY-LINKED EDUCATION FOR ADULT AND WORKING LIFE (London: Harper & Row).

Layton, D. (ed.) (1984), THE ALTERNATIVE ROAD: THE REHABILITATION OF THE PRACTICAL (The University of Leeds).

Le Compte, M. and Geertz, J. (1984), "Ethnographic Data Collection in Evaluation Research" in Fetterman, D. (ed.) ETHNOGRAPHY IN EDUCATIONAL EVALUATION.

Locke, J. (1690), AN ESSAY CONCERNING HUMAN UNDERSTANDING, (ed.) A.D. Woozley (London: Fontana/Collins).

Mabey, C. (1986), GRADUATES INTO INDUSTRY (Aldershot: Gower).

Mackintosh, I. (1986), SUNRISE EUROPE: THE DYNAMICS OF INFORMATION TECHNOLOGY (Basil Blackwell).

Maguire, M. and Ashton D. (1981), "Employers' Perceptions and Use of Educational Qualifications" in EDUCATION ANALYSIS, 1981.

Manpower Services Commission (1977), YOUNG PEOPLE AND WORK: REPORT ON THE FEASIBILITY OF A NEW PROGRAMME OF OPPORTUNITIES FOR UNEMPLOYED YOUNG PEOPLE, UNDER THE CHAIRMANSHIP OF GEOFFREY HOLLAND (London: MSC).

Manpower Services Commission (1985), THE IMPACT OF NEW TECHNOLOGY ON SKILLS IN MANUFACTURING AND SERVICES (MSC).

Marchello, J. (1987), "Education for a Technological Age", FUTURES, (October 1987, pp.555-565).

Marshall, T.H. (1963), "Citizenship and Social Class", in SOCIOLOGY AT THE CROSSROADS (London: Heinemann), pp.111-115.

Marstrand, P. (ed.) (1984), NEW TECHNOLOGY AND THE FUTURE OF WORK AND SKILLS (London: Frances Pinter).

McCulloch, G., Jenkins, E. and Layton, D. (1985), TECHNOLOGICAL REVOLUTION? THE POLITICS OF SCHOOL SCIENCE AND TECHNOLOGY IN ENGLAND AND WALES SINCE 1945 (Falmer Press).

McNay, I. and Ozga, J. (1985) POLICY-MAKING IN EDUCATION: THE BREAKDOWN OF CONSENSUS (Open University/Pergamon Press).

Medawar, P. (1979), ADVICE TO A YOUNG SCIENTIST (London: Harper & Row).

Medawar, P. (1963), "Is the scientific paper a fraud?", THE LISTENER, 12.9.63, pp.377-8 (London: BBC Publications).

Merton, R., Fiske, M. and Kendall, P. (1956), THE FOCUSED INTERVIEW: A MANUAL OF PROBLEMS AND PROCEDURES (Illinois: Free Press).

Michie, D. and Johnston, R. (1984), THE CREATIVE COMPUTER - MACHINE INTELLIGENCE AND HUMAN KNOWLEDGE (Pelican)

Miles, M. and Huberman, A., (1984), QUALITATIVE DATA ANALYSIS: A SOURCEBOOK OF NEW METHODS (California: Sage).

Mill, J.S. (1961), A SYSTEM OF LOGIC (London: Longman).

Moore, R. (1984), "Schooling and the world of work" in Bates et al SCHOOLING FOR THE DOLE? (London: Macmillan).

Moore, R. (1987), "Education and the ideology of production", BRITISH JOURNAL OF SOCIOLOGY OF EDUCATION (vol. 8, no. 2, pp.227-242).

Morishima, M. (1985), THE PRODUCTION OF TECHNOLOGISTS AND ROBOTIZATION IN JAPAN (London: Toyota Centre/London School of Economics).

Moser, C.A. (1958), SURVEY METHODS IN SOCIAL INVESTIGATION (London: Heinemann).

MSC (1978), YOUNG PEOPLE AND WORK (London: HMSO).

Mukherjee, S. (1974), THERE'S WORK TO BE DONE: UNEMPLOYMENT AND MANPOWER POLICIES (MSC: HMSO, London).

Nash, I. (1987), "Debugging the equality system", TIMES EDUCATIONAL SUPPLEMENT (26.6.87, p. 11).

National Computing Centre (1982), WORKING WITH COMPUTERS (NCC Publications).

NEDC/MSC (1984), COMPETENCE AND COMPETITION (London: NEDO).

NEDO (1987), IT FUTURES ... IT CAN WORK (London: NEDO).

Newton, K. and Leckie, N. (1987), "Employment effects of technological change", NEW TECHNOLOGY, WORK AND EMPLOYMENT (Vol. 2, no. 2, pp.112-125).

Northcott, J. (1986), MICROELECTRONICS IN INDUSTRY: PROMISE AND PERFORMANCE (London: Policy Study Institute).

Norton-Grubb, W. (1984), "The Bandwagon Once More: Vocational Preparation for High-Tech occupations" in HARVARD EDUCATIONAL REVIEW, Vol. 54, No. 4, November 1984.

O'Brien, G. (1986), PSYCHOLOGY OF WORK AND UNEMPLOYMENT (Chichester: John Wiley).

O'Connor, D.J. (1982), "Two concepts of education", JOURNAL OF PHILOSOPHY OF EDUCATION (vol. 16, no. 2, pp.137-146).

OPCS (1980), CLASSIFICATION OF OCCUPATIONS 1980 (London: HMSO).

OPCS (1986), LABOUR FORCE SURVEY 1983 and 1984 (London: HMSO).

O'Shea, T. and Self, J. (1983) LEARNING AND TEACHING WITH COMPUTERS (Brighton: Harvester Press).

Papert, S. (1980), MINDSTORMS (Brighton: Harvester Press).

Parsons, D. (1984), EMPLOYMENT AND MANPOWER SURVEYS: A PRACTITIONERS GUIDE (Gower).

Parsons, D. (1985), CHANGING PATTERNS OF EMPLOYMENT IN GREAT BRITAIN - A CONTEXT FOR EDUCATION (Sheffield: MSC).

Pearson, R. (1987), "Key Skills for Biotechnology" in SKILL NEEDS FOR TECHNOLOGICAL INNOVATION: MSC SEMINAR REPORT (Sheffield: MSC).

Pearson, R., Hutt, R. and Parsons, D (1984), EDUCATION, TRAINING AND EMPLOYMENT (Gower).

Perry, J. and Barnett, C. (1985), SKILLS IN SCHOOLS (York: Longman for the School Curriculum Development Committee).

Peters, R.S. (1966) ETHICS AND EDUCATION, pp.32-34 (London: Unwin).

Popper, K. (1959), THE LOGIC OF SCIENTIFIC DISCOVERY (London: Hutchinson).

Popper, K. (1963), CONJECTURES AND REFUTATIONS: THE GROWTH OF SCIENTIFIC KNOWLEDGE (London: Routledge and Kegan Paul).

Rajan, A. (1975), TRAINING AND RECRUITMENT EFFECTS OF TECHNICAL CHANGE (Gower).

Rajan, A. (1984), NEW TECHNOLOGY AND EMPLOYMENT IN INSURANCE, BANKING AND BUILDING SOCIETIES: RECENT EXPERIENCE AND FUTURE IMPACT (Gower).

Raven, J. (1984), COMPETENCE IN MODERN SOCIETY: ITS IDENTIFICATION, DEVELOPMENT AND RELEASE (H.K. Lewis, London).

Reeder, D. (1979), "A Recurring Debate: Education and Industry" in Bernbaum, G. SCHOOLING IN DECLINE (Macmillan)

Reinecke, I. (1982), THE MICRO INVADERS (Australia: Penguin).

Richardson, S., Dohrenwend, B. and Klein, D. (1965), INTERVIEWING: ITS FORMS AND FUNCTIONS (New York: Basic Books).

Roberts, K. (1984), SCHOOL LEAVERS AND THEIR PROSPECTS - YOUTH AND THE LABOUR MARKET IN THE 1980's (Open University Press).

Roberts, K. (1983), YOUTH AND LEISURE (George Allen and Unwin).

Robertson, J. (1985), FUTURE WORK (Gower/Maurice Temple Smith).

Roizen, J. and Jepson, M. (1985), DEGREES FOR JOBS: EMPLOYERS EXPECTATIONS OF HIGHER EDUCATION (SRHE AND NFER-NELSON).

Roszak, T. (1986), THE CULT OF INFORMATION: THE FOLKLORE OF COMPUTERS AND THE TRUE ART OF THINKING (Cambridge: Lutterworth Press).

Rothwell, R. (1981) "Technology, Structural Change and Manufacturing Employment", in OMEGA, Vol. 9, No. 3, 1981, pp.229-245.

Rothwell, R. and Zegveld, W. (1985), REINDUSTRIALIZATION AND TECHNOLOGY (Longman).

Rowe, C. (1986), PEOPLE AND CHIPS - THE HUMAN IMPLICATIONS OF INFORMATION TECHNOLOGY (Paradigm Publishing: London).

Rowntree, D. (1985), EDUCATIONAL TECHNOLOGY IN CURRICULUM DEVELOPMENT (London: Harper and Row).

Rudduck, J. (1985), "A Case for Case Records? A Discussion of some Aspects of Lawrence Stenhouse's Work in Case Study Methodology" in Burgess, R.G. (ed.) (1985a), pp.101-119.

Ryle, G. (1949), THE CONCEPT OF MIND (London: Hutchinson).

Sackman, H. (1976), "A sceptic at the oracle" FUTURES 8, pp.444-446.

Satin, A. and Shastry, W. (1983), SURVEY SAMPLING (Ottawa: Census and Household Survey Methods Division).

Schatzman, L. and Strauss, A. (1973), FIELD RESEARCH: STRATEGIES FOR A NATURAL SOCIOLOGY, (Englewood Cliffes, N.J.: Prentice-Hall).

Schon, D. (1971), BEYOND THE STABLE STATE (Temple Smith).

Schon, D. (1983), THE REFLECTIVE PRACTITIONER (Temple Smith).

Sendov, B. (1986), "The second wave: problems of computer education", in Ennals, R., Gwyn, R. and Zdravchev, L. (eds.) INFORMATION TECHNOLOGY AND EDUCATION (Chichester: Ellis Horwood).

Seward-Thompson, B. (1987), "Attitudes in the IT industry - the key to the future, INFORMATION TECHNOLOGY AND PUBLIC POLICY (Vol. 6, no. 1, pp.25-27).

Shallis, M. (1984), THE SILICON IDOL (Oxford: Oxford University Press).

Showler B. and Sinfield A. (1981), THE WORKLESS STATE: STUDIES IN UNEMPLOYMENT (Martin Robertson: Oxford).

Sinfield, A. (1981), WHAT UNEMPLOYMENT MEANS (Oxford: Martin Robertson).

Skilbeck, M. (1983), "Lawrence Stenhouse: research methodology" in BRITISH EDUCATIONAL RESEARCH JOURNAL, Vol. 9, no. 1, 1983.

Sleigh, J., Boatright, B., Irwin, P. and Stanyon, R. (1979), THE MANPOWER IMPLICATIONS OF MICROELECTONICS TECHNOLOGY (London: HMSO).

Smith, D.J. (ed.) (1985) INFORMATION TECHNOLOGY AND EDUCATION (ESRC).

Smith, J.M. (1972), INTERVIEWING IN MARKET AND SOCIAL RESEARCH (London: Routledge and Kegan Paul).

Social Europe: Supplement 1/86 (1986), NEW TECHNOLOGY AND SOCIAL CHANGE (Luxembourg: EEC).

Spradley, J.P. (1980), PARTICIPANT OBSERVATION (New York: Holt, Rhinehart and Winston).

St. John Brooks, C. (1985), WHO CONTROLS TRAINING? - THE RISE OF THE MANPOWER SERVICES COMMISSION (Fabian Society: London).

Steele, R. and Wellington, J. (1985), "Hardware and Humans", in TIMES EDUCATIONAL SUPPLEMENT (26.4.85).

Stenhouse, L. (1975), AN INTRODUCTION TO CURRICULUM RESEARCH AND DEVELOPMENT (London: Heinemann).

Stenhouse, L. (1978), "Case study and case records: towards a contemporary history of education", BRITISH EDUCATIONAL RESEARCH JOURNAL, (4, 2, pp.21-39).

Stenhouse, L. (1979), "The Problem of Standards in illuminative research", SCOTTISH EDUCATIONAL REVIEW, 11.1.79.

Stenhouse, L. (1980), "The study of samples and the study of cases", BRITISH JOURNAL OF EDUCATIONAL STUDIES (Vol. 6, no. 1, pp.1-6).

Stenhouse L. (1982), "The conduct, analysis and reporting of case study in educational research and evaluation", in McCormick, R. (ed.) CALLING EDUCATION TO ACCOUNT (London: Heinemann), pp.261-273.

Stenhouse, L. (1984), "Library access, library use and user education in sixth forms: an autobiographical account", in Burgess, R.J. (ed.), THE RESEARCH PROCESS IN EDUCATIONAL SETTINGS: TEN CASE STUDIES (Lewes: Falmer Press).

Stenhouse, L. (1985), "A Note on Case Study and Educational Practice", in Burgess, R.G. (ed.) (1985b), pp.263-271.

Stonier, T. (1983), THE WEALTH OF INFORMATION: A PROFILE OF POST-INDUSTRIAL SOCIETY (London: Methuen).

Stonier, T. and Conlin, C. (1985), THE THREE C's: CHILDREN, COMPUTERS AND COMMUNICATION (John Wiley).

Straker, N. (1987), "Mathematics teacher shortages in secondary schools", RESEARCH PAPERS IN EDUCATION (Vol. 2, no. 2, pp.126-152).

Taylor, W.H. (1985), "Productivity and Educational Values", in Worswick, G.D.N. (1985), EDUCATION AND ECONOMIC PERFORMANCE (Aldershot: Gower Press).

Thatcher, M. (1982), "Introduction" in Department of Industry, MICROS IN SCHOOLS SCHEME (London: HMSO).

Toffler, A. (1980), THE THIRD WAVE (London: Pan).

Touraine, A. (1971), THE POST-INDUSTRIAL SOCIETY (New York: Random House).

Townsend, C. (1982), SKILLS NEEDED FOR YOUNG PEOPLE's JOBS: VOLUME I-V (Brighton: IMS/MSC).

Turkle, S. (1984), THE SECOND SELF: COMPUTERS AND THE HUMAN SPIRIT (London: Granada).

Vallee, J. (1982), THE NETWORK REVOLUTION - CONFESSIONS OF A COMPUTER SCIENTIST (Penguin).

Varlaam, C., (ed.) (1984) RETHINKING TRANSITION: EDUCATIONAL INNOVATION AND THE TRANSITION TO ADULT LIFE (Lewes: Falmer Press).

Virgo, P. (1986), ANALYSIS OF SEVERITY OF SKILL SHORTAGES (Manchester: NCC).

Walker, R. and Adelman, C. (1972), TOWARDS A SOCIOGRAPHY OF CLASSROOMS (Final Report, London: SSRC).

Walker, R. (1985), DOING RESEARCH (London: Methuen).

Walker, S. and Barton, L. (1986), YOUTH, UNEMPLOYMENT AND SCHOOLING (Open University Press).

Wallace, R.G. (1985), INTRODUCING TECHNICAL AND VOCATIONAL EDUCATION (Macmillan).

Ward, R. (1983), INFORMATION TECHNOLOGY IN SCHOOLS (London: Equal Opportunities Commission).

Watts, A.G. (1978), "The Implications of School-Leaver Unemployment for Careers Education in Schools" in JOURNAL OF CURRICULUM STUDIES 1978, Vol. 10, No. 3, pp.233-250.

Watts, A.G. (1983a), THE FUTURE OF WORK EXPERIENCE - AND WORK (Heinemann).

Watts, A.G. (1983b), EDUCATION, UNEMPLOYMENT AND THE FUTURE OF WORK (Open University Press; Milton Keynes).

Weizenbaum, J. (1984), COMPUTER POWER AND HUMAN REASON (Penguin Books).

Weizenbaum, J. (1979), "Once more the Computer Revolution" in Dertouzos and Moses,(ed.) (1979), pp.439-458.

Wellington, J.J. (1985), "The knowledge we have lost in information", TIMES EDUCATIONAL SUPPLEMENT, 31.8.84.

Wellington, J.J. (1985a), CHILDREN, COMPUTERS AND THE CURRICULUM (London: Harper and Row).

Wellington, J.J. (1985b), "Computers across the curriculum - the needs in teacher training", in JOURNAL OF FURTHER AND HIGHER EDUCATION.

Wellington, J.J. (1986a), "Pre-vocational education and the needs of employers", in THE VOCATIONAL ASPECT OF EDUCATION, April 1986.

Wellington, J.J. (1986b), "Sunset Training" in TIMES EDUCATIONAL SUPPLEMENT, 23.5.86, page 20.

Wellington, J.J. (ed.) (1986c), CONTROVERSIAL ISSUES IN THE CURRICULUM (Oxford: Basil Blackwell).

Wellington, J.J. (1986d), "Jobs on the Line", in the TIMES EDUCATIONAL SUPPLEMENT, 13.6.86, page 34.

Wellington, J.J. (1988), IT AND EDUCATION: AN ANNOTATED BIBLIOGRAPHY (Lancaster: University of Lancaster).

Wells, K. (1987), "Scientific Issues in the Conduct of Case Studies", JOURNAL OF CHILD PSYCHOLOGY AND PSYCHIATRY (Vol. 28, no. 6, pp.783-790).

Welsh Office, (1987), WELSH EDUCATON STATISTICS BULLETIN, No. 3, SURVEY OF MICROCOMPUTERS IN SCHOOLS (Cardiff: Welsh Office).

Whiston, T.G. (1977), EDUCATION, WORKSTYLES AND SOCIAL DEVELOPMENT: A MISMATCH OF ABILITIES (139th Meeting of the BAAS, Aston University).

Whiston, T., Senker, P. and Macdonald, P. (1980), AN ANNOTATED BIBLIOGRAPHY ON TECHNOLOGICAL CHANGE AND EDUCATIONAL DEVELOPMENT (Paris: UNESCO).

White, J. (1982), THE AIMS OF EDUCATION RE-STATED (London: Routledge & Kegan Paul).

Whyte, J. et al (eds.) (1985), GIRL FRIENDLY SCHOOLING (London: Methuen).

Wittgenstein, L. (1963), PHILOSOPHICAL INVESTIGATIONS, 2nd edition (Oxford: Blackwell).

Wolcott, H.F. (1984) "Ethnographers Sans Ethnography: The Evaluation Compromise" in Fetterman, D. (ed.) (1984).

Wood, T. (1985), CURRENT APPLICATIONS OF MICROELECTRONICS IN SHIPBUILDING AND DISTRIBUTION AND THE IMPLICATIONS FOR FURTHER AND HIGHER EDUCATION IN THE NORTH EAST REGION (University of Newcastle, unpublished Ph.D. thesis).

Woods, P. (1985), "Ethnography and Theory Construction in Educational Research" in Burgess, R.G. (ed.) (1985).

Woods, P. (1986), INSIDE SCHOOLS: ETHNOGRAPHY IN EDUCATIONAL RESEARCH (London: Routledge and Kegan Paul).

Woodward, K. (ed.) (1980), THE MYTHS OF INFORMATION: TECHNOLOGY AND POST-INDUSTRIAL CULTURE (London: Routledge & Kegan Paul).

Worswick, G.D.N. (ed.) (1985), EDUCATION AND ECONOMIC PERFORMANCE (Aldershot: Gower Press).

Yin, R. (1984), CASE STUDY RESEARCH (California: Sage).

Young, D. (1985), KNOWING HOW AND KNOWING THAT: A PHILOSOPHY OF THE VOCATIONAL (Birbeck College, Haldane Memorial Lecture, 1984).

Youngman, M.B. (1986), DESIGNING AND ANALYSING QUESTIONNAIRES (University of Nottingham).

Zicklin, G. (1987), "Numerical control machining and the issue of deskilling", WORK AND OCCUPATIONS (vol. 14, no. 3, pp.452-466).

Zorkoczy, P. (1985), AN INTRODUCTON TO INFORMATION TECHNOLOGY, 2nd edition (London: Pitman).

TABLE 1

THE STANDARD INDUSTRIAL CLASSIFICATION OF EMPLOYMENT (SIC)

SINCE 1980

Division	Description
0	Agriculture, Forestry and Fishing
1	Energy and Water Supply
2	Mineral and ore extraction; metal manufacture
3	Metal goods, engineering and vehicles
4	Other manufacturing industries
5	Construction
6	Distribution, hotels, catering, repairs
7	Transport and Communication
8	Banking, finance, insurance
9	Other services

TABLE 2

NUMBERS EMPLOYED IN DIFFERENT SECTORS AS A PERCENTAGE OF TOTAL WORKING POPULATION

DIVISION	NUMBERS EMPLOYED IN THOUSANDS	% OF TOTAL
0	300.2	1.4%
1	491.0	2.3%
2	761.8	3.6%
3	2245	10.5%
4	2064	9.7%
5	988	4.6%
6	4387	20.5%
7	1335	6.2%
8	2306	10.8%
9	6498	30.4%
TOTAL: 0-9	21377	100

(Source: Employment Gazette, 1988)

TABLE 3

CHANGES IN EMPLOYMENT: 1982-1986

SIC 1980	Numbers Employed September 1982	Numbers Employed September 1986	% Change
0	363 x 1000	338 x 1000	- 6.9%
1	666	519	- 22%
2	857	773	- 9.8%
3	2661	2306	- 13.3%
4	2172	2087	- 3.9%
5	1045	984	- 5.8%
6	4034	4332	+ 7.1%
7	1351	1332	- 2.1%
8	1782	2231	+ 25.2%
9	5905	6268	+ 6.1%
TOTAL	20838 x 1000	21160 x 1000	+ 1.5%

(Source: Employment Gazette, February 1987)

TABLE 4

NUMBERS EMPLOYED IN FOUR INFORMATION TECHNOLOGY (IT) SECTORS AS A PERCENTAGE OF TOTAL WORKING POPULATION

SIC DIVISION	NUMBERS EMPLOYED	% OF TOTAL WORKING POPULATION
33 (Data Processing Equipment Manf.)	75.1 x 1000	0.36%
344 (Telecommunication Equipment)	199.7 x 1000	0.95%
7902 (Telecommunications)	217.9 x 1000	1.03%
8394 (Computer Services)	68.5 x 1000	0.32%
TOTAL IN 4 IT SECTORS	561.2 x 1000	2.66%

(Source: Employment Gazette, November 1986 - more recent figures not available in all 4 sectors.)

TABLE 5

IT CHANGES IN EMPLOYMENT

SIC 1980	Numbers Employed September 1982	Numbers Employed June 1986	% Change
33 (Data Processing Equipment Manf.)	72.8 x 1000	75.1 x 1000	+ 3%
344 (Telecommunication Equipment)	198.2	199.7	+0.75%
7902 (Telecommunications)	N/A	217.9	-
8394 (Computer Services)	N/A	68.5	-

(Source: Employment Gazette, November 1986)

TABLE 6: JAPANESE LABOUR TRENDS: 1975-1980

	1975	1980	% CHANGE
PRIMARY INDUSTRY			
Agriculture, Forestry & Fisheries	7354 x 10^3	6111	- 17%
SECONDARY INDUSTRY			
e.g. Manufacturing	13236	13246	+ 0.07%
TERTIARY INDUSTRY			
e.g. services, insurance, communications	27522	30901	+12.2%
TOTAL EMPLOYMENT	53141 x 10^3	55811	+ 5%

(sources: Monthly Statistics of Japan, August 1984 and NIPPON: a charted survey of Japan, 1984/85)

TABLE 7: LABOUR TRENDS IN BRITAIN: 1978-1982

	1978	1982	% CHANGE
PRIMARY INDUSTRY			
(Agriculture, Forestry and Fishing)	382×10^3	354	- 3.5%
Manufacturing	7257	5764	- 19.9%
SERVICES	7314	7643	+ 4.5%
TOTAL EMPLOYMENT	22777 $\times 10^3$	21223	- 7.3%

(source: CSO: Annual Abstraction of Statistics, HMSO, 1984)

TABLE 8: 'O' LEVEL ENTRIES AND RESULTS IN COMPUTER STUDIES 1976-1985

Year:	GIRLS			BOYS		
	Total entry	%A-C	%A-E	Total entry	%A-C	%A-E
1976	892	60.1	86.4	2359	59.6	83.9
1977	1701	58.0	82.1	4593	66.4	85.9
1978	2198	53.3	81.5	5674	61.4	84.7
1979	3024	55.3	81.5	7483	61.9	84.4
1980	6692	53.7	81.9	10036	67.5	87.1
1981	8952	48.2	79.9	15000	60.2	85.2
1982	10346	51.4	81.9	22918	60.9	85.5
1983	13322	51.3	82.3	30527	60.6	86.3
1984	16570	52.3	82.7	39055	61.4	87.1
1985	18538	53.1	81.8	43947	61.3	86.0

(Source: D.E.S. Statistics of Education, Vol. 2)

C.S.E. ENTRIES AND RESULTS IN COMPUTER STUDIES 1983-1985

Year:	GIRLS			BOYS		
	Total entry	% Grade 1	% Grade 5	Total entry	% Grade 1	% Grade 5
1983	15444	8.8	91.0	39329	10.8	90.1
1984	18169	9.1	92.0	35767	11.7	91.0
1985	21512	9.1	92.0	35767	11.7	91.0

(Source: D.E.S.)

(Note: DES figures not currently available for 1986 and 1987 due to restructuring.)

TABLE 9: TOP 12 'O' LEVEL ENTRIES IN ENGLAND: 1984

1.	English Language	538,650
2.	Mathematics	316,239
3.	English Literature	235,239
4.	Biology	223,596
5.	Geography	190,031
6.	Physics	183,705
7.	Chemistry	150,968
8.	French	150,703
9.	Art	140,961
10.	History	124,053
11.	Religious Studies	68,789
12.	Computer Studies	55,625

(Source: Survey of Examining Boards of England, D.E.S.)

TABLE 10: FROM VERTICAL TO HORIZONTAL: THE EVOLUTION OF IT EDUCATION IN SECONDARY SCHOOLS

Stage 1:	Computer Studies as an examination subject: rapid rise in entries. "Vertical" approach to IT education.
Stage 2:	Computer awareness across the board, to all ability ranges and both sexes e.g. to the whole first year, with an element of in-service education for staff as well as pupils.
Stage 3:	Introduction of computers across the curriculum in separate subjects to enhance learning in those areas, partly as a result of the "diffusion" process in stage 2 i.e. CAL across the curriculum.
Stage 4:	Increasing pressure on Computer Studies as a separate subject, and on the computer room as a resource for the whole school.
Stage 5:	Integration of computing, and computing resources, into the whole curriculum and classroom practice. "Horizontal" approach to IT education.

TABLE 11: AIMS OF THE TECHNICAL AND VOCATIONAL EDUCATION INITIATIVE

a. **In conjunction with LEAs** to explore and test ways of organising and managing the education of 14-to-18 year olds across the ability range so that:
   - i. more of them are attracted to seek the qualifications/skills which will be of direct value to them at work and more of them achieve these qualifications and skills;
   - ii. they are better equipped to enter the world of employment which will await them;
   - iii. they acquire a more direct appreciation of the practical application of the qualifications for which they are working;
   - iv. they become accustomed to using their skills and knowledge to solve the real-world problems they will meet at work;
   - v. more emphasis is placed on developing initiative, motivation and enterprise as well as problem-solving skills and other aspects of personal development;
   - vi. the construction of the bridge from education to work is begun earlier by giving these young people the opportunity to have direct contact and training/planned work experience with a number of local employers in the relevant specialisms;
   - vii. there is close collaboration between local education authorities and industry/commerce/public services etc., so that the curriculum has industry's confidence.

b. To undertake a. in such a way that:
   - i. the detailed aims can be achieved quickly and cost effectively;
   - ii. the educational lessons learned can be readily applied in other localities and to other groups among the 14-18 year olds;
   - iii. the educational structures/schemes established to further the aims of the initiative should be consistent with progressive developments in skill and vocational training outside the school environment, existing vocational education for under-16 year olds and higher education;
   - iv. emphasis is placed on careful monitoring and evaluation;
   - v. individual projects are managed at local level;
   - vi. the overall conduct, assessment and development of the initiative can be assessed and monitored by the MSC and the TVEI Unit it has established for this purpose.

(from The TVEI Operating Manual, MSC, 1983)

TABLE 12: INFORMATION TECHNOLOGY COURSES IN TVEI SCHOOLS (1)

(A) COURSES LABELLED 'INFORMATION TECHNOLOGY' (2)

	TVEI PUPILS				NON-TVEI PUPILS			
	Boys	Girls	Total	% Girls	Boys	Girls	Total	% Girls
1983	448	326	774	42%	97	59	156	38%
1984	1918	1072	2990	36%	370	330	700	47%
1985	2273	1359	3632	37%	1240	1139	2379	48%
1986	2579	2461	5040	49%	1854	1815	3669	49%

(B) 'BUSINESS STUDIES AND INFORMATION TECHNOLOGY'

	TVEI PUPILS				NON-TVEI PUPILS			
	Boys	Girls	Total	% Girls	Boys	Girls	Total	% Girls
1983	4	24	28	86%	28	94	122	77%
1984	474	654	1128	58%	14	110	124	89%
1985	512	504	1016	50%	254	326	580	56%
1986	600	1092	1692	65%	90	150	240	62%

(Source: National TVEI *Curriculum* Database Unit, Trenty Polytechnic)

Notes

(1) Based on a total sample of 466 TVEI schools in 1986-87, with an estimated 17,600 TVEI pupils and 53,000 non-TVEI pupils. This sample includes 103 Round 1 (1983) schools, 223 Round 2 schools (1984), 52 Round 3 schools (1985) and 88 Round 4 schools (1986).

(2) Four courses are included with this label, given the codes C27, T17, J56 and B82 on the database.

TABLE 13A: UNIVERSITY FIRST DEGREE GRADUATES* IN I.T. RELATED SUBJECTS 1979-84

Subject	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	% increase 1978/79-83/84
Computer Science	-	-	882	1,166	1,437	1,588	
	2,767	2,808	2,097	2,124	2,296	2,474	47
Maths			2,097	2,124	2,296	2,474	
Physics	1,179	1,840	1,933	2,145	2,288	2,426	41
Electrical/ Electronic Engineering**	1,555	1,627	1,755	1,909	2,160	2,305	48
All Eng./Tech. Subjects	6,980	7,247	7,707	8,117	8,570	8,694	24
All Subjects	60,517	61,948	63,787	66,198	68,842	67,912	12

* Home students only

** Includes electronic and electrical engineering courses

(Source: UGC and IMS, 1986)

TABLE 13B: POLYTECHNIC FIRST DEGREE GRADUATES* IN I.T. RELATED SUBJECTS 1979-1984

Subject	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	% increase 1978/79-83/84
Maths. & Computer Science	376	451	573	589	752	953	153
(Computer Science)	(296)	(360)	n.a.	n.a.	n.a.	(618)	(109)
Physics	70	77	107	92	95	122	74
Electrical/ Electronic Engineering	547	523	595	591	626	791	45
Total All Eng./ Tech. Subjects	2,685	2,650	2,721	2,962	3,018	3,428	28
All Subjects	18,194	18,260	19,036	19,881	21,015	25,615	41

* Totals *exclude* those overseas graduates returning home after completion of their course

(Source: Polytechnic First Destination Statistics: IMS, 1986)

TABLE 14: SOME LANDMARKS IN IT EDUCATION: 1980-88

DATE	TITLE	DESCRIPTION
1981-84	Micros in School Programme	£16m subsidy from DTI for purchase of micro-computers in schools.
1980-86	Microelectronics Education Programme (MEP)	DES supported initiative (£23m) to promote microelectronics teaching and use of computers in school education
1981	ITeCs (Information Technology Centres)	Government initiative to train young people in IT skills. 175 ITeCs now operating, approx. 6000 trainees
1982	Information Technology Year (IT 82)	Government programme to increase national awareness of IT
1982	YTS	Youth Training Scheme
1982	IT initiative launched for higher education	Designed to increase number of places in higher education and post-graduate courses related to IT from 1983-1986
1982	"New Blood" Initiative	Money provided for higher education to recruit lecturers/ researchers in IT (70 posts)
1983	TVEI	Technical and Vocational Education Initiative
1984	Information Technology in Further Education	Government grant designed to provide vocational students with an education taking account of the industrial and commercial applications of IT

continued ...

TABLE 14: SOME LANDMARKS IN IT EDUCATION: 1980-88 (continued)

DATE	TITLE	DESCRIPTION
1985	Engineering and Technology Initiative	£43m funding to increase the number of places in engineering and technology in higher education by around 5000 by 1990
1985	IT SA (IT skills agency)	Agency set up by industry to monitor skill shortages in IT and encourage collaboration of industry, government and education
1985-86	DTI software subsidy	£3.5m provided to DTI to subsidise purchase of educational software in schools
1986	Modem scheme	DTI subsidy of £1m to enable schools to purchase a modem for their micro, allowing links between computer systems
1986	TVEI extension announced	White Paper, 'Working Together - Education and Training', announces national extension of TVEI programme, with "average annual expenditure of £90 million" over next 10 years.
1986-87	Microelectronics Support Unit (MESU)	Set up with £3m funding for 1986-87 to carry on the work of the MEP
1987	DES support for IT in Schools and Further Education	Kenneth Baker (on May 7th) announces Educational Support Grants of £19 million for the "expansion of IT in the schools" and 4.8 million for IT in non-advanced. F.E.

TABLE 15: MAKES OF COMPUTER IN SCHOOLS RESPONDING TO THE TTNS SURVEY

Make	Number	Percentage of Total
BBC	1672	84%
COMMODORE/PET	140	7%
RML	63	3%
APPLE	46	2%
AMSTRAD	15	1%
OTHERS	62	3%
TOTAL	1998	100%

TABLE 16: LOCATIONS OF COMPUTERS IN SCHOOLS

	%
COMPUTING LABS.	66.8
BUSINESS STUDIES	6.3
SCIENCE etc.	4.6
ADMINISTRATION	3.6
CDT	3.5
TROLLIES	2.7
MATHS	2.7
SPECIAL EDUCATION	2.0
OFFICE STUDIES etc.	1.3
LIBRARY	1.1
MODERN LANGUAGES	.8
OTHERS	4.5

TABLE 17: NATURE AND AMOUNT OF NON-TEACHING ASSISTANCE IN IT EDUCATION

	%
NO TECHNICAL SUPPORT	67
MINIMAL TECHNICIAN SUPPORT	19
FULL-TIME TECHNICIAN	6
TVEI TECHNICIAN AVAILABLE	6
SECRETARIAL HELP AVAILABLE	3

TABLE 18: SCHOOL SUBJECTS USING CAL

SUBJECT	1st	2nd	3rd	4th	5th	6th	TOTAL	% OF OVERALL TOTAL
SCIENCE	6	0	16	6	3	7	38	23%
MATHS	9	2	2	4	1	2	20	12%
SPECIAL	17	1	0	1	0	0	19	12%
CDT	6	1	5	4	0	0	16	10%
MODERN LANGUAGES	5	2	4	2	1	0	14	9%
ENGLISH	5	2	1	3	0	0	11	7%
BUSINESS STUDIES	1	0	2	4	0	2	9	5%
HISTORY	2	3	2	0	0	0	7	4%
GEOGRAPHY	2	1	1	2	0	1	7	4%
MUSIC	2	1	1	1	0	0	5	3%
COM. STUDIES	1	0	2	1	0	1	4	2%
HOME ECONOMICS	2	0	1	1	0	0	4	2%
OFFICE STUDIES	0	0	0	0	1	2	3	2%
OTHERS	4	1	1	1	0	0	7	4%
TOTAL NUMBERS	62	12	36	30	6	13	164	100%

TABLE 19: NETWORKING AND THE INCIDENCE OF CAL IN SCHOOL SUBJECTS

(a) CAL USED IN 4 OR MORE SUBJECTS

% OF NETWORKED SCHOOLS USING CAL IN 4 OR MORE SUBJECTS	% OF NON-NETWORKED SCHOOLS USING CAL IN 4 OR MORE SUBJECTS
21%	27%

(b) CAL USED IN 3 OR LESS SUBJECTS

% OF NETWORKED SCHOOLS USING CAL IN 3 OR LESS SUBJECTS	% OF NON-NETWORKED SCHOOLS USING CAL IN 3 OR LESS SUBJECTS
79%	73%

TABLE 20: NUMBERS OF SUBJECTS USING CAL IN NETWORKED AND NON-NETWORKED SCHOOLS

Number of Subjects Using CAL	% of Non-Networked Schools	% of Networked Schools
0	33%	32%
1	18%	25%
2	12%	13%
3	9%	9%
4	9%	8%
5	12%	8%
6	0%	4%
7	3%	2%
8	3%	0%

TABLE 21: CAL AND TECHNICAL ASSISTANCE

	AVERAGE NUMBER OF SUBJECTS USING CAL
Schools with not technical assistance for IT	1.7
Schools with technical assistance for IT	2.5

TABLE 22: CERTIFICATED COURSES IN ITeCs

COURSE	% of ITeCs Using the Course
City & Guilds 726	81
RSA Wordprocessing	37
RSA Computer Literacy and Information Technology	23
RSA Typing	22
BTEC General Business Studies	15
BTEC National Business Studies	11
City & Guilds 223	11
City & Guilds 224	11
APPROXIMATELY 8% USED:	
BTEC Information Technology	
Cambridge University IT	
City & Guilds 953	
City & Guilds 417	
Pitmans Word Processing	
RSA Audio Typing	
RSA Keyboard Skills	
RSA Office Skills	
RSA Practical Commercial Profile	
RSA Shorthand	
RSA Vocational Preparation	
Scotrec	
APPROXIMATELY 4% USED:	
City & Guilds 418	
City & Guilds 444	
HNC Dataprocessing	
WTEC Worldprocessing	
OTHER COURSES USED BY FEW ITeCS:	
City & Guilds 756	
Milton Keynes Diploma in Micro Applications	
City & Guilds 756	

TABLE 23: DESTINATIONS OF ITeC TRAINEES

	% Range	% Average
(a) Employment directly related to IT	10-95	60
(b) Employment not related to IT	0-50	16
(c) Further Education	0-30	9
(d) Unemployment or other	0-36	15

TABLE 24: THE STATED PURPOSE OF AN ITeC

	Percentage
Providing IT training for YTS	93%
Provide a service and general advice to Industry and the Community	48%
Adult Training	41%
Providing open access........................	33%
Providing training for industry	33%
Commercial activities	19%
To survive	15%
Teachers resource centre	11%
Supporting needs of local industry	11%
Provide work experience for CPVE, TVEI, PEP .	8%
Help youngsters to develop into adults	7%
Computer repair	4%
Viewdata service	4%
Promote interests outside work	4%
Pursuit of excellence	4%
"To make trainees academically acceptable for higher training in those areas where vacancies occur only at HND level and above"	4%

TABLE 25: ITeCs: STRUCTURE FOR ANALYSING INTERVIEWS

1. THE ITeC ITSELF
   - 1.1 Staffing
   - 1.2 Resources

2. INTAKE AND SELECTION POLICIES
   - 2.1 Selection procedures e.g. by careers services
   - 2.2 Criteria used
   - 2.3 Background of trainees
   - 2.4 Gender and ethnic problems

3. CURRICULUM OFFERED
   - 3.1 Gender divisions
   - 3.2 Curriculum details and approaches
   - 3.3 Work placements
   - 3.4 Certification and Assessment

4. DESTINATIONS OF TRAINEES

5. THE PURPOSE OF AN ITeC
   - 5.1 Income Generation
   - 5.2 Outcome and Development of the Trainees
   - 5.3 The success and achievement of ITeCs

6. LINKS AND ATTITUDES
   - 6.1 Industry links and attitudes
   - 6.2 School links and attitudes

TABLE 26: QUALIFICATIONS OF ITeC TRAINEES ON ENTRY TO YTS COMPARED WITH MODE A TRAINEES

(1) % of ITeC/Mode A Trainees with O-Level, CSE 1, City & Guilds, Equivalent or Higher Qualification at time of entry to YTS;

(2) % Achieving any of the above qualification during training or within 3 months of leaving.

		(1) on entry	(2) gained
SCOTLAND	ITeC	81.5	40.7
	Mode A	62.2	14.4
NORTHERN	ITeC	71.4	33.3
	Mode A	46.9	11.7
NORTH WEST	ITeC	66.2	42.3
	Mode A	54	16.5
YORKS & HUMBERSIDE	ITeC	68.1	18.2
	Mode A	46.2	12
MIDLANDS	ITeC	62.6	18.7
	Mode A	50.7	16.8
WALES	ITeC	73.7	57.9
	Mode A	48.7	11.7
SOUTH WEST	ITeC	76.9	23.1
	Mode A	57.3	24
SOUTH EAST	ITeC	58.5	24.1
	Mode A	52.1	20.2
LONDON	ITeC	47.1	0
	Mode A	50	17.9
NATIONAL	ITeC	67	31.5
	Mode A	52.3	16.5

(Source: Manpower Services Commission)

TABLE 27: EMPLOYMENT OF ITeC TRAINEES THREE MONTHS AFTER LEAVING

% of leavers in employment (full-time or part-time) after 3 months.

A. BY REGION

	ITeC Leavers	Mode A Leavers
SCOTLAND	47	56
NORTHERN	44	53
NORTH WEST	50	61
YORKSHIRE & HUMBERSIDE	48	62
MIDLANDS	54	62
WALES	47	56
SOUTH WEST	60	70
SOUTH EAST	71	74
LONDON	49	70
NATIONAL	53	64
B. AREA EXAMPLES		
(i) ITeC leavers' employment rate lower than Mode A:		
LEEDS	30	69
MANCHESTER CENTRAL	33	64
LONDON NORTH EAST	41	69
(ii) ITeC leavers' employment rate higher than Mode A:		
HIGH WYCOMBE	87	78
LANARKSHIRE	65	48
DUDLEY	74	54

(Source: 100% Survey of YTS Leavers: April-November 1985, Manpower Services Commission)

TABLE 28: NUMBER OF PEOPLE RECRUITED PER 1000 OF THE EXISTING WORKFORCE

	Recruited for non-IT purposes	Recruited for IT purposes	Total
Graduate	2	4	6
HNC/HND	0.5	1	1.5
18+ with A Levels............	0.5	1.5	2
16+ with O Levels	7	0	7
YTS trainees from outside the organisation	0	0	0
YTS trainees from within the organisation	6	0	6
Others (mainly experienced workers with low qualifications	10	0	0
	TOTAL 32.5 per 1000 or 3.25%		

TABLE 29: CHANNELS FOR GRADUATE RECRUITMENT

	Matching Sample	Extra IT Providers	Total
Recruiting Publications	2	5	7
National Advertisement	3	1	4
Milk Round	4	0	4
Specialist Agencies	3	1	4
University Careers Service .	1	2	3
Sponsorship	2	0	2
Recruitment Fairs	1	1	2
Unsolicited Applications ...	1	1	2
Personal Contacts	1	1	2

TABLE 30: CHANNELS FOR NON-GRADUATE RECRUITMENT

	Matching Sample	Extra IT Providers	Total
Local Newspaper Advert	9	1	10
YTS	9	0	9
Local Careers Office or Job Centre	4	2	6
Personal Contact	2	3	5
Trade Journals	3	0	3
Direct Approach to Schools & Colleges	3	0	3
Unsolicited Applications ..	2	0	2
Apprenticeship	2	0	2

TABLE 31: SUMMARY OF SELECTION CRITERIA

CRITERION	Matching Sample		Extra IT Suppliers	TOTAL
	Non-IT Recruitment	IT Recruitment	IT Recruitment	
Teamwork	3	8	8	19
Aptitude tests	4	3	3	16
Ability to relate to colleagues	5	5	6	16
Specific I.T. skills ...	5	7	2	14
Communication skills ...	2	5	4	11
Ability to relate to strangers	5	2	4	11
Academic qualifications (see text)	4	3	3	10
Ability to learn	3	3	4	10
Personal Appearance	4	2	4	10
Enthusiasm	1	2	5	8
Commitment (to unsocial hours etc.)	2	3	3	8
Leadership Qualities ...	3	1	3	7
Ambition	3	1	2	6
Previous Experience	1	3	1	5
Outside Interests.......	0	2	3	5
Interest in work itself .	1	1	3	5
Honesty	2	2	0	4
Reliability	2	1	1	4
Written Presentation	1	1	1	3
Flexibility	1	2	0	3
Manual Dexterity	2	0	1	3
Verbal Presentation	0	3	0	3
Initiative	1	1	1	3
Ability to Work Unsupervised	0	1	2	3
Long Term Commitment	2	0	0	2
Prepared to Move South ..	0	0	2	2
Evidence of Personal Career Planning	0	0	2	2

TABLE 32: DIFFICULTIES IN RECRUITMENT

Area of Difficulty	Matching Sample		Extra I.T. Providers		Totals	
	Work Not Involving I.T.	Work Involving IT.T	Work Not Involving I.T.	Work Involving I.T.	Not I.T.	I.T.
None, or not mentioned	19	10	18	6	37	27
Systems Programmers & Software Specialists	0	5	0	2	0	7
Graduates:						
Experienced of any discipline	2	2	0	2	2	4
Physics	0	0	0	4	0	4
New of any discipline	1	2	0	0	1	2
Electronics	0	1	0	2	0	3
Computer Studies	0	0	0	2	0	2
Chemistry or Chemical Engineering	0	0	0	2	0	2
Metallurgy	0	0	1	0	1	0
Food Technology	0	0	1	0	1	0
Specific Shortages (Graduate or Non-Graduate)						
Telecommunications Experience	0	2	0	0	0	2
IBM Environment	0	1	0	1	0	2
ICL Environment	0	0	0	1	0	1
Technical Sales	1	0	0	1	1	1
4th generation languages	0	0	0	1	0	1
Reliable PCB Assemblers	0	0	0	1	0	1
Electronics Component Buyers	0	0	0	1	0	1
Hotel Receptionists	1	0	0	0	1	0
18 year olds with A levels and living in London	0	1	0	1	0	1

TABLE 33: SUBJECT OF COMMENT MADE BY EMPLOYERS REGARDING EDUCATION AND TRAINING

Group	Description	Matching Sample	Extra IT Providers	Total
1	Courses should be more relevant to the needs of industry and commerce	5	8	13
2	I.T. as an integral part of people's general education	4	6	10
3	The lack of suitably qualified teachers in I.T. related subjects	2	7	9
4	The importance of a good basic and general education	3	3	6
5	Poor advice to pupils, especially girls, about I.T.	2	3	5
6	Satisfied with system as it stands	4	0	4
7	The Usefulness of YTS	2	2	4
8	The incorporation of teamwork into education	1	3	4
9	The need for I.T. awareness among management	2	1	3
10	The provision of equipment for I.T. in schools..................	0	3	3
11	Doubts regarding the school exam system	2	0	2
12	The expense of commercial training programmes	2	0	2

TABLE 34: CATEGORIES OF I.T. USE MENTIONED BY EMPLOYERS

Category	Number of Times Mentioned	Frequency as a Percentage
1	69	17%
2	47	12%
3	91	22%
4	23	6%
5	51	13%
6	27	7%
7	64	16%
8	20	5%
9	13	3%

TABLE 35: NUMBER OF RECRUITS EMPLOYED "IN A TYPICAL YEAR" FROM FIVE LEVELS OF EDUCATION, FOR GENERAL AND I.T. RELATED JOBS

	General		I.T. Related	
Graduate level and above	1727	20%	564	40%
Further education, e.g. HNC/HND, B/TEC	1497	18%	305	22%
School leavers at 18+ ...	1922	22%	284	20%
School leavers at 16+ ...	2023	24%	194	14%
YTS Trainees	1382	16%	61	4%

TABLE 36: LEVELS OF EDUCATION AND WORK PERFORMED

(i) Levels of Education of I.T. Recruits by Types of I.T. Work Performed (as a percentage of numbers in level of Education)

Category of I.T. Task	Graduate	F.E.	18+	16+	YTS
1	27	19	5	2	3
2	26	19	9	7	8
3	13	8	6	0	2
4	5	16	29	16	11
5	24	34	44	62	61
6	3	3	6	13	15
TOTAL	100	100	100	100	100

(ii) Levels of Education of I.T. Recruits by Types of I.T. Work Performed (as a percentage of numbers in each category of work)

	1	2	3	4	5	6
Graduate ..	46	38	43	7	11	9
F.E.	35	30	29	21	17	9
18+	11	16	25	43	25	21
16+	4	9	0	20	29	35
YTS	4	8	4	9	19	26
TOTAL	100	100	100	100	100	100

TABLE 37: EMPLOYERS' SELECTION CRITERIA: GENERAL

Level \ Selection Criteria	Specific Skills	General Skills	Personal Appearance	Personal Qualities	Personal Potential	Academic Achievement
Graduate and above A	8* (0%)	423 (24%)	50 (3%)	349 (20%)	67 (4%)	830 (48%)
HND etc. B	8 (10%)	384 (26%)	103 (7%)	276 (18%)	35 (2%)	691 (46%)
School Leaver at 18+ C	64 (3%)	402 (21%)	134 (7%)	420 (22%)	327 (17%)	575 (30%)
School Leaver at 16+ D	116 (6%)	238 (12%)	249 (12%)	749 (37%)	313 (15%)	358 (18%)
YTS Trainee E	8 (0%)	153 (11%)	268 (19%)	582 (42%)	62 (4%)	309 (22%)
WEIGHTED COLUMN TOTALS	204	1600	804	2376	804	2763

* criterion weighted by number of recruits to which it applies. The percentage in brackets shows the relative importance of each criterion at a given level.

TABLE 38: EMPLOYERS' SELECTION CRITERIA: I.T. POSTS

Selection Criteria / Level	Specific Skills	General Skills	Personal Appearance	Personal Qualities	Personal Potential	Academic Achievement
Graduate and above A	1 (0%)	236 (42%)	11 (2%)	9 (2%)	28 (5%)	279 (49%)
HND etc. B	19 (6%)	112 (37%)	6 (2%)	10 (3%)	11 (4%)	147 (48%)
School leaver at 18+ C	67 (24%)	85 (30%)	3 (1%)	18 (6%)	53 (19%)	58 (20%)
School leaver at 16+ D	74 (38%)	40 (21%)	6 (3%)	13 (7%)	5 (3%)	56 (29%)
YTS Trainee E	12 (20%)	6 (10%)	0 (0%)	15 (25%)	2 (3%)	26 (43%)
COLUMN TOTALS	173	479	26	65	99	566

TABLE 39: COMPARISON OF ORGANISATIONS OFFERING IN-HOUSE TRAINING WITH THOSE NOT OFFERING TRAINING

	Mean Number of Employees	Mean Number of Graduate Recruits	Mean Number of Graduate Recruits in I.T.
Organisations Offering In-House Training	1997	33	14
Organisations Not Offering In-House Training	1015	4	3

TABLE 40: CASE-STUDY SAMPLE MATRIX

VARIABLES →	SIC SECTOR	SIZE	YEAR OF EST.	LOCATION	IT USER/ IT PROVIDER
CASES ↓					
1. CASE A	3	1300 employees	1978/ 1979	South West	IT Provider
2. CASE B	3	310 employees	1868 (1960: PLC)	North	IT User
3. CASE C	8	90 employees	1970	Midlands	IT Provider and User
4. CASE D	4	32,000 employees	1725 1969 (RM Merger)	North	IT User
5. CASE E	3	650 employees	1939	East	IT Provider

TABLE 41: CASE-STUDY PROTOCOL

Stage I: Gaining Access

1. Make personal contact
2. Establish Key Informants
3. Plan Itinerary and duration

Stage II: Collecting Data: General Guidelines

IIA: Sources of Evidence

1. Documentation
2. Records/archives
3. Interviews (focused or open-ended)
4. Direct Observation (possibly including Photographs)
5. Physical artefacts

IIB: Areas Or Issues to be Investigated

1. Basic information about the organisation (sources 1,2,3,4,5): size; SIC sector; year of establishment; structures; changes in workforce; physical resources and artefacts.
2. Recruitment (sources 1 and 3)
   At different levels; patterns over time; trends in number of employees.
3. Prior Skill requirements (sources 1, 3, 4)
   General skills and abilities; prior IT skills.
4. On-the-job skills and work patterns (sources 1-5).
5. Skill shortages (sources 1-3).
   Levels of shortage; actual jobs; poaching/turnover.
6. Education and training (1, 3).
   In-house training and development; training needs; views on present provision.
7. Staff perceptions of: their work environment; their 'use' by the company; the training they have received; company management (3, plus informal discussion).
8. Future developments with respect to skills, training and recruitment. (Refer to Employers' Interview Schedule).

TABLE 41: CASE-STUDY PROTOCOL (continued)

Stage III: Formation of a Case-Study

Contents List

Organisation of the following material:

Narrative of the case-study (times, places, people)

Tapes

Discs (if any)

Transcriptions of interviews

Documents

Records

Photographic Material

Field Notes

Stage IV: Report and Analysis of the Case-Studies

Strategy for analysis

Patterns emerging

Explanation building

Written report

Stage V: Cross-Case Analysis

When a single case is part of a multiple-case study there may be five levels of question. Only levels 1 and 2 will be covered by the single case:

Level 1: questions asked of specific interviewees;

Level 2: questions asked of the individual case (these are the questions in the case-study protocol);

Level 3: questions asked of the findings across multiple cases;

Level 4: questions asked of an entire study - for example, calling on information beyond the multiple cases and including other literature that may have been reviewed;

Level 5: normative questions about policy recommendations and conclusions, going beyond the narrow scope of the study.

(after Yin, 1984, page 72)

Levels 3 and 4 will need to be considered in the final stage of case-study research.

TABLE 42: CONTACT SUMMARY SHEET FOR CASE-STUDIES

Date: Site:

1. Main issues or themes emerging

2. Which key questions did the contact relate most closely to?

3. Information collected

4. Next contact with this case

TABLE 43: ADMISSIONS TO UNIVERSITY UNDERGRADUATE COMPUTING COURSES

	Male	Female	Total
1979	1,269 (74%)	438 (26%)	1,707
1980	1,481 (74%)	515 (26%)	1,996
1981	1,586 (75%)	520 (25%)	2,106
1982	1,489 (78%)	412 (22%)	1,901
1983	1,554 (80%)	381 (20%)	1,935
1984	1,728 (83%)	342 (17%)	2,070
1985	1,585 (87%)	243 (13%)	1,828
1986	1,639 (86%)	261 (14%)	1,900

Source: University Central Council on Admissions, Cheltenham

TABLE 44: YOUNG PEOPLE ON 'A' LEVEL COURSES AND YTS

(AS A PERCENTAGE OF 16-YEAR OLD POPULATION)

	A-level Pupils	YTS/YOP
1979/80	19.4%	5.1%
1980/81	19.6%	9.6%
1981/82	20.5%	13.0%
1982/83	20.3%	18.2%
1983/84	19.6%	23.8%
1984/85	19.2%	25.8%

(Source: Commons Select Committee on Education, 1986)

TABLE 45: SOURCES OF FIRST-TIME EMPLOYMENT OF YOUNG PEOPLE in 1976

Manufacturing	35%
Distribution, transport and communication	25%
Miscellaneous service industries	12%
Professional and financial services	12%
Construction	10%
Other	6%

(Source: Holland Report, Young People and Work, MSC, London 1977)

TABLE 46: EMPLOYERS' SELECTION STRATEGIES SUGGESTED IN 1980

Academic Criteria dominate I	II	III	IV	Diverse range of non-academic criteri V
Academic qualifications dominate at all stages of selection	Educational qualifications used for short-listing; final decision of non-academic criteria	Non-academic criteria begin to dominate; educational qualifications perform a focussing function only	All emphasis on non-academic criteria	Educational qualification perform a negative function

(after Ashton, D. and Maguire, M. (1980))

TABLE 47: VOCATIONALISM IN THE CURRICULUM: A SPECTRUM OF APPROACHES

SPECIFIC AIMS ⟷ GENERAL AIMS

SPECIFIC SKILLS	GENERIC TRANSFERABLE SKILLS	COGNITIVE AND AFFECTIVE DOMAIN AIMS
Direct approach in terms of specific skills - preparation for jobs	e.g. problem-solving decision-making	Psychological "health" e.g. success in learning, learning how to learn; confidence; no fear of making mistakes; no fear of new technology; motivation, drive.
Objections (i) Trivialisation of education (ii) Rapid change in a technological world	Objections (i) Are skills transferable i.e. domain-independent? (ii) Are skills knowledge independent? (iii) Transfer may be person dependent	c.f. 'Trainability' (Taylor,1985) 'Native Abilities' (Dore, 1987)
c.f. early ITeC approach	Objections to transfer (i) Only takes place within closely related domains (ii) Needs to be explicitly taught for.	

TABLE 48: THREE WAVES OF I.T. IN SECONDARY EDUCATION

Three Waves	Educational Dimension	Curriculum Dimension	Vocational Dimension
First Wave Appendage	Additional content, little change in method	Seclusion, discrete subject	Highly significant
Second Wave Tool	Effect on method	Diffusion	Critical
Third Wave Agent of Change	Effect on content and structure	Change in curriculum view	Realistic

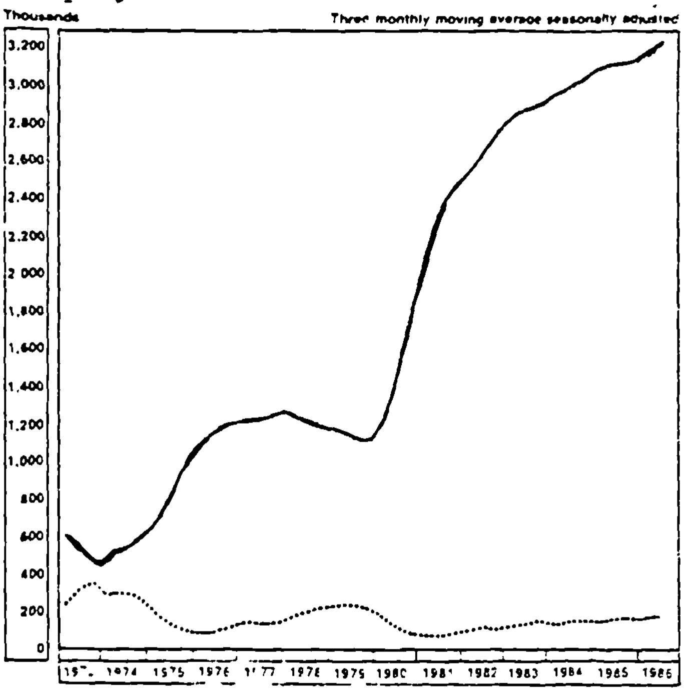
TABLE 49: THREE PRESSURES ON I.T. IN EDUCATION

AREAS OF PRESSURE	KEY POINTS
1. Pedagogic	Interactive Active Learning Involves Learner participation Individual or group work
2. Sociological	Parents Education Authorities Governments European and International Organisations
3. Economic	I.T. present in all economic sectors Need for "I.T. skills" Shortages of I.T. personnel

(developed from Ceryoh (1985))

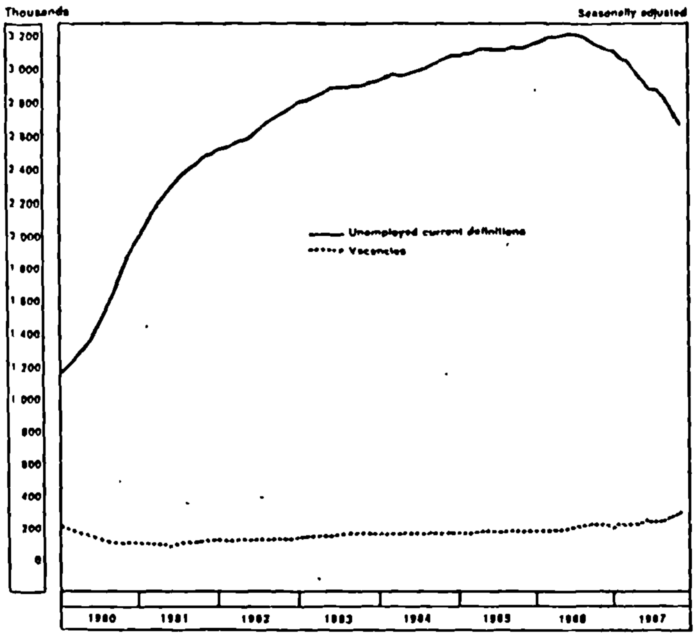
FIGURE 1: UNEMPLOYMENT: 1973-1988

Unemployment and Vacancies: United Kingdom



(Source: Employment Gazette, November 1986)

Unemployment and Vacancies: United Kingdom



(Source: Employment Gazette, January 1988)

FIGURE 2: NUMBERS OF EMPLOYESS IN EACH SIC DIVISION

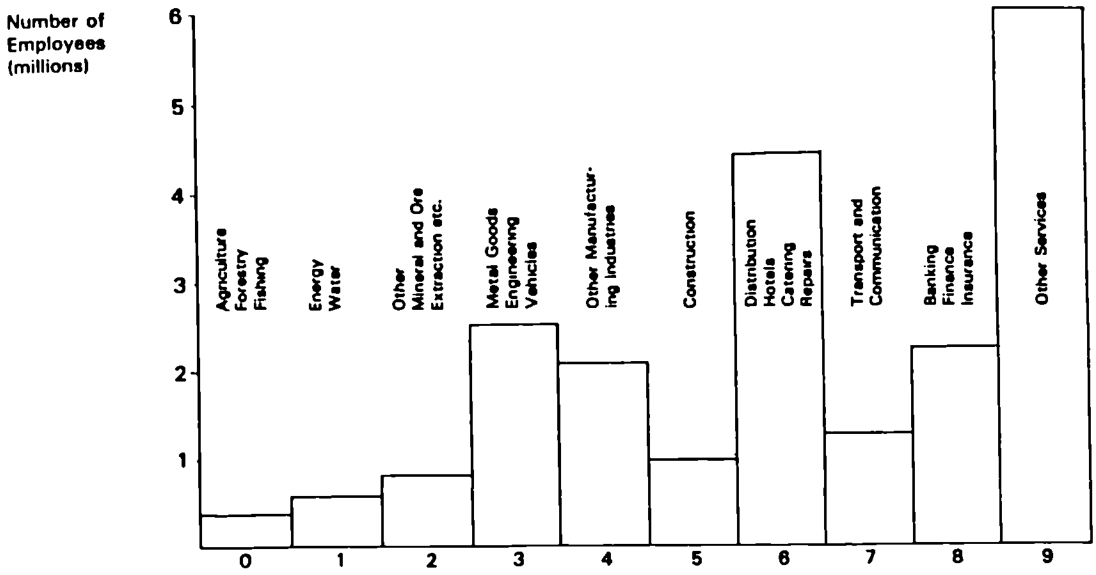
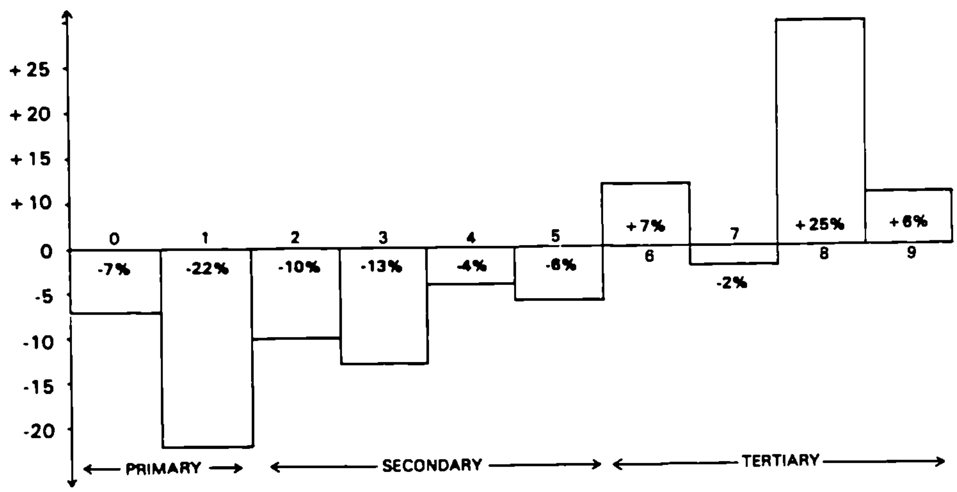
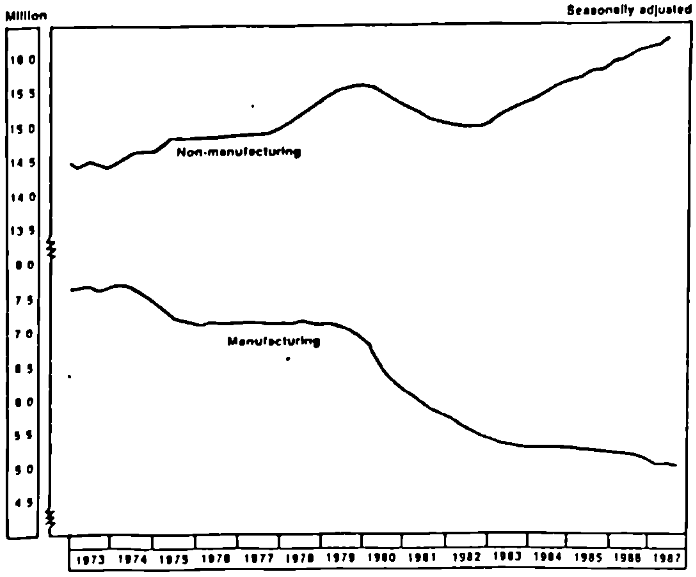


FIGURE 4: CHANGING EMPLOYMENT PATTERNS IN THE TEN SECTORS: 1982-1986



(sources for figs. 2 and 4: Wellington, J.J., using figures from the Department of Employment)

FIGURE 3: MANUFACTURING AND NON-MANUFACTURING EMPLOYESS IN EMPLOYMENT



(Source: Employment Gazette, January 1988)

FIGURE 5: NUMBERS OF CANDIDATES ENTERING 'O'-LEVEL COMPUTER STUDIES: 1983-1985

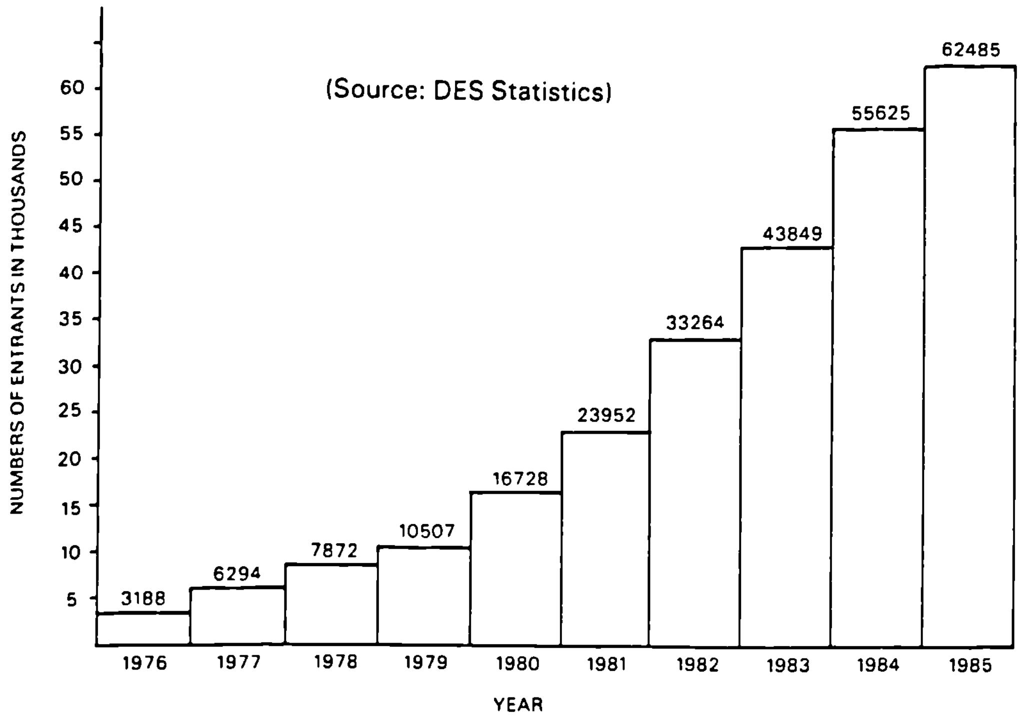


FIGURE 6: MAKE OF COMPUTER IN ITeCs

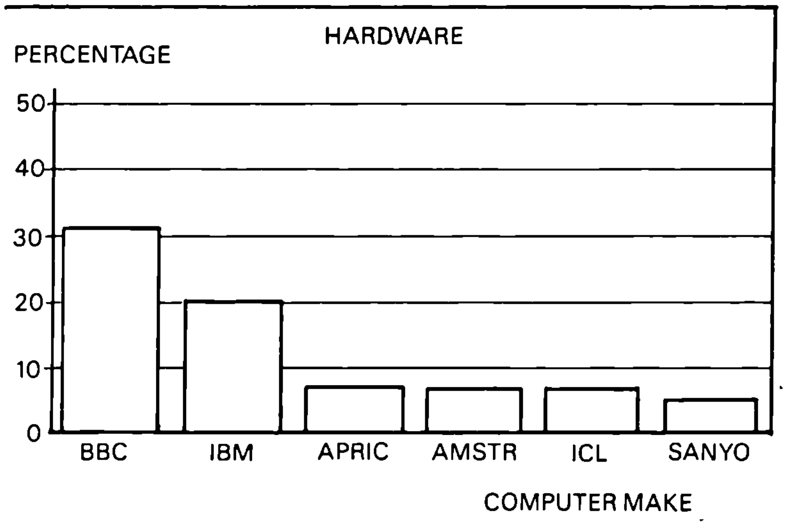


FIGURE 7: DESTINATIONS OF TRAINEES AS REPORTED BY ITeC STAFF

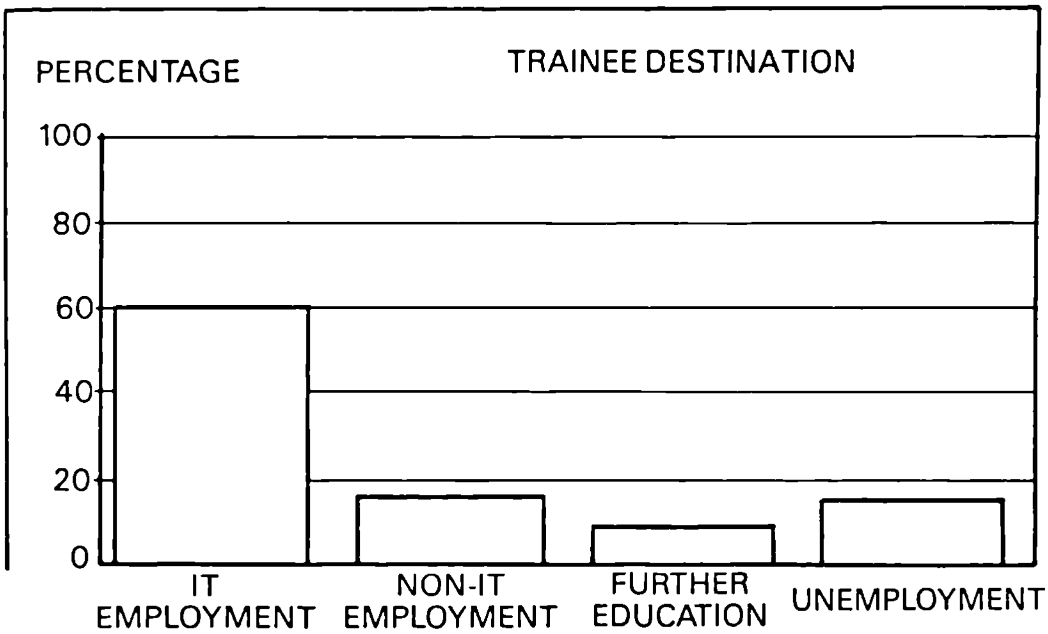
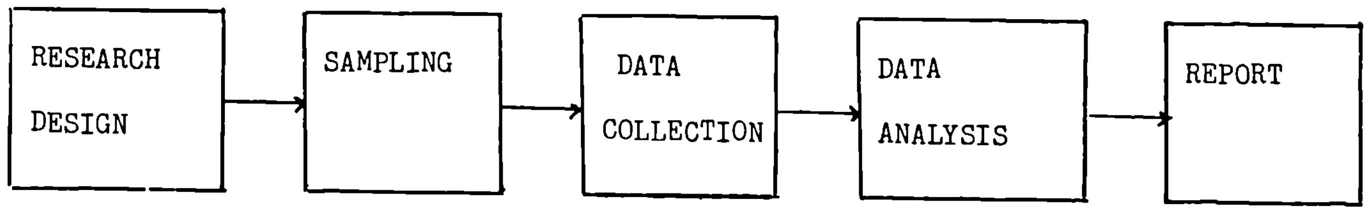


FIGURE 8: AN IDEAL-TYPICAL RESEARCH PROCESS



Source: Robert G. Burgess, Field Methods in the Study of Education (Falmer Press, 1985, page 6)

FIGURE 9: A NON-LINEAR APPROACH TO RESEARCH

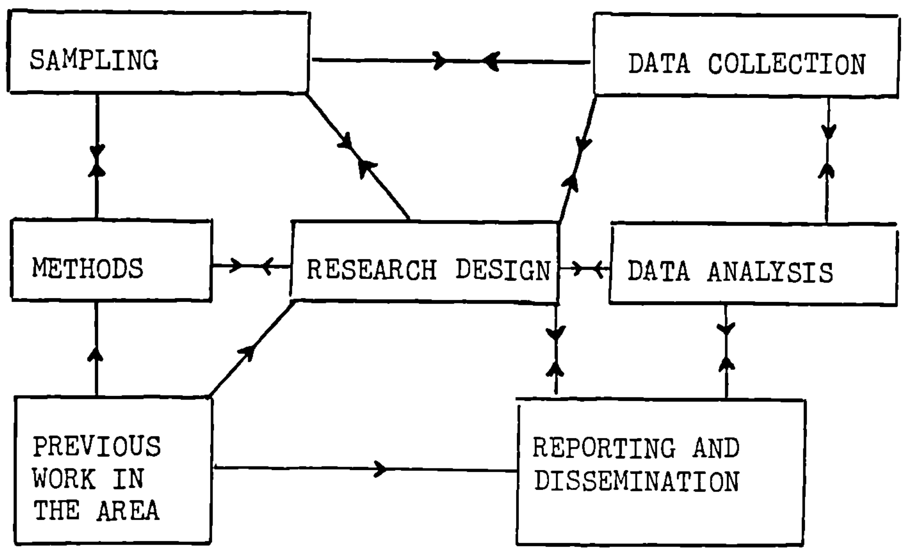


FIGURE 10: PERCENTAGE OF RECRUITS FROM FOUR LEVELS OF EDUCATION (EXCLUDING YTS) PERFORMING EACH CATEGORY OF IT TASK

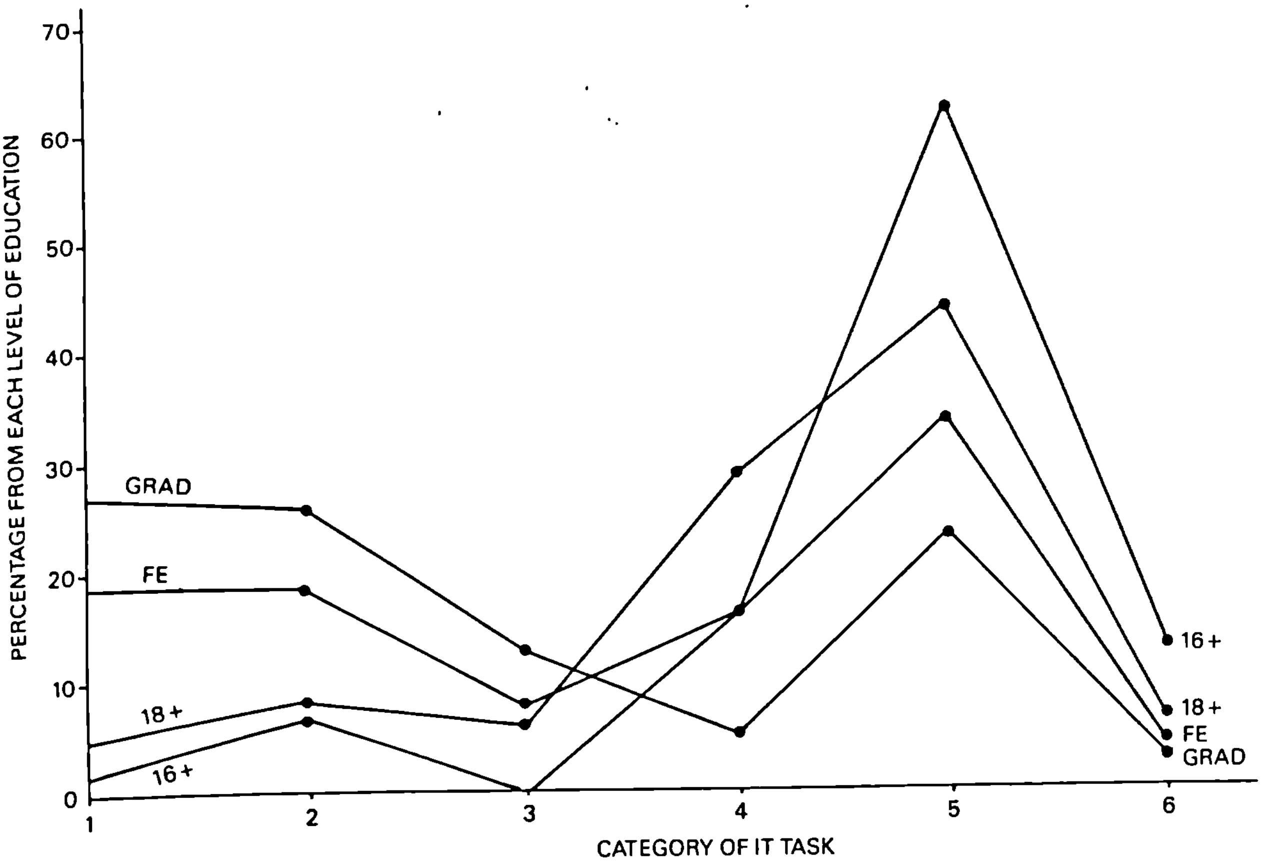
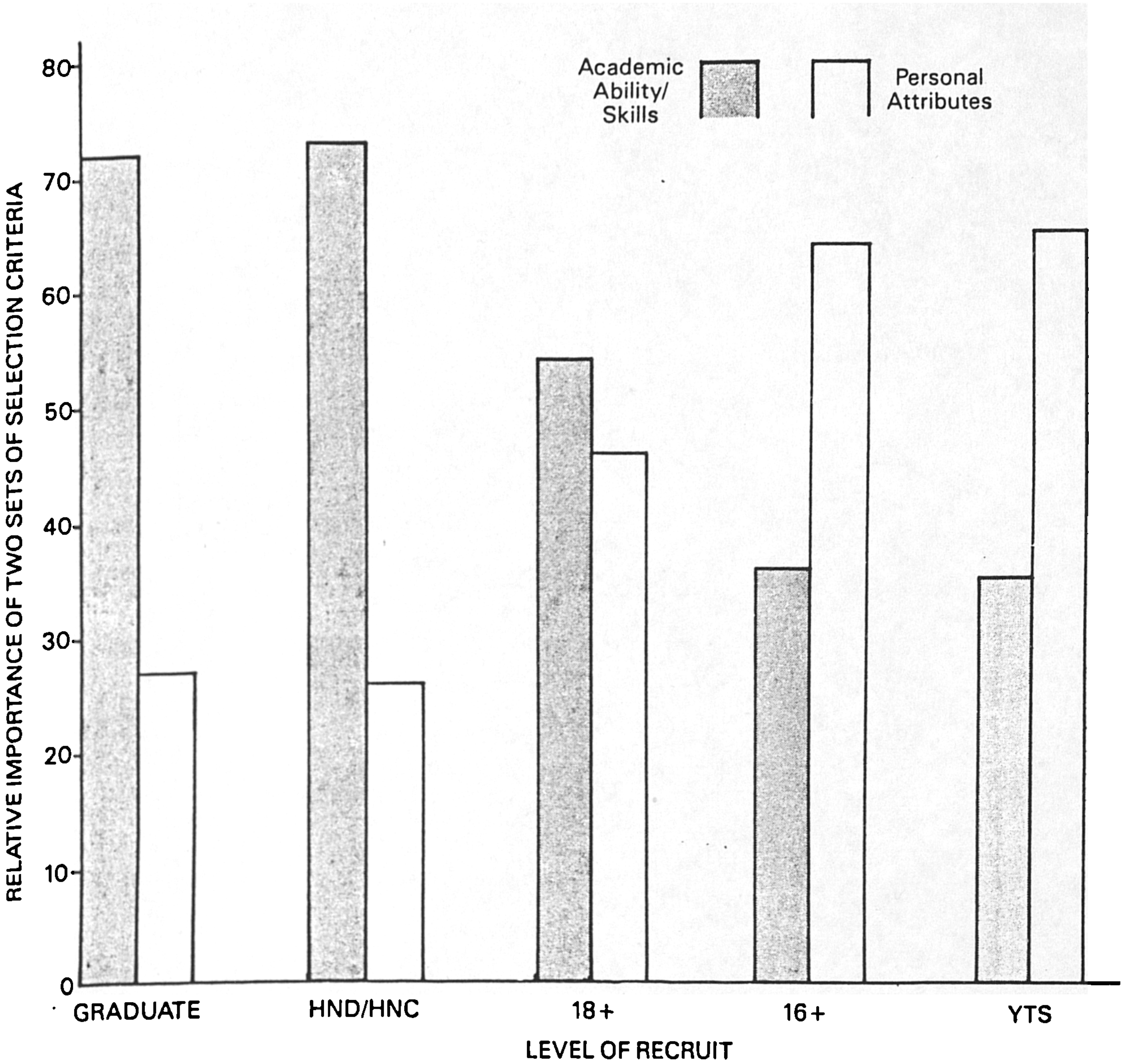
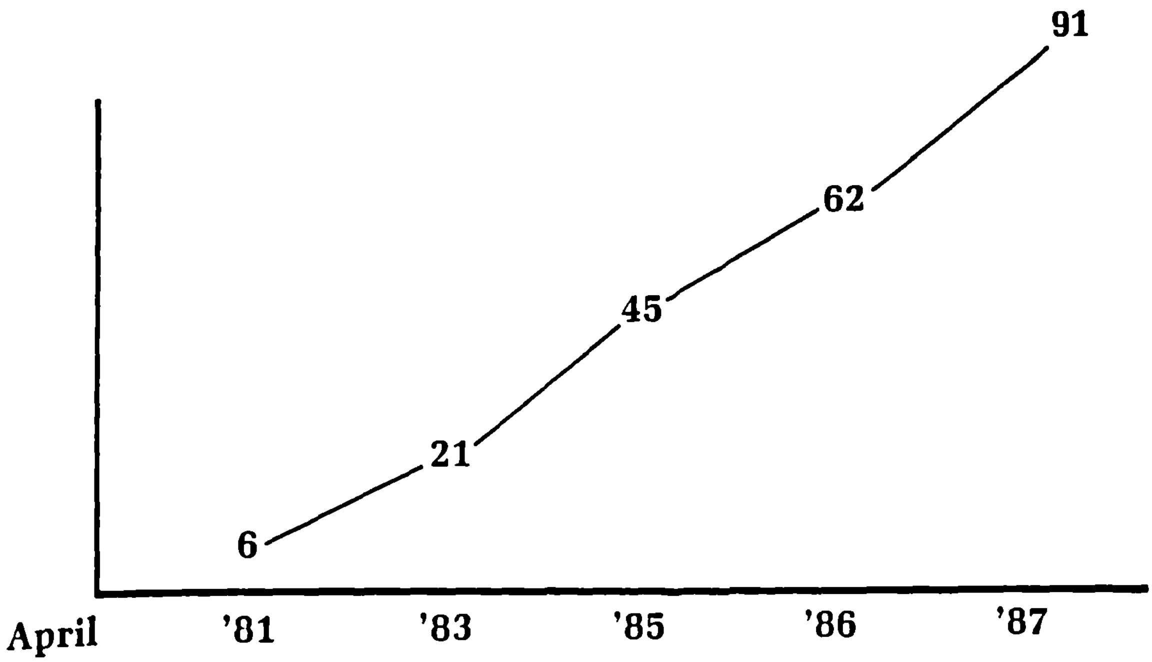


FIGURE 11: RELATIVE IMPORTANCE OF ACADEMIC ABILITY AND SKILLS VERSUS PERSONAL ATTRIBUTES IN EMPLOYERS' REQUIREMENTS AT DIFFERENT LEVELS OF RECRUITMENT



CASE C: FIGURE 12

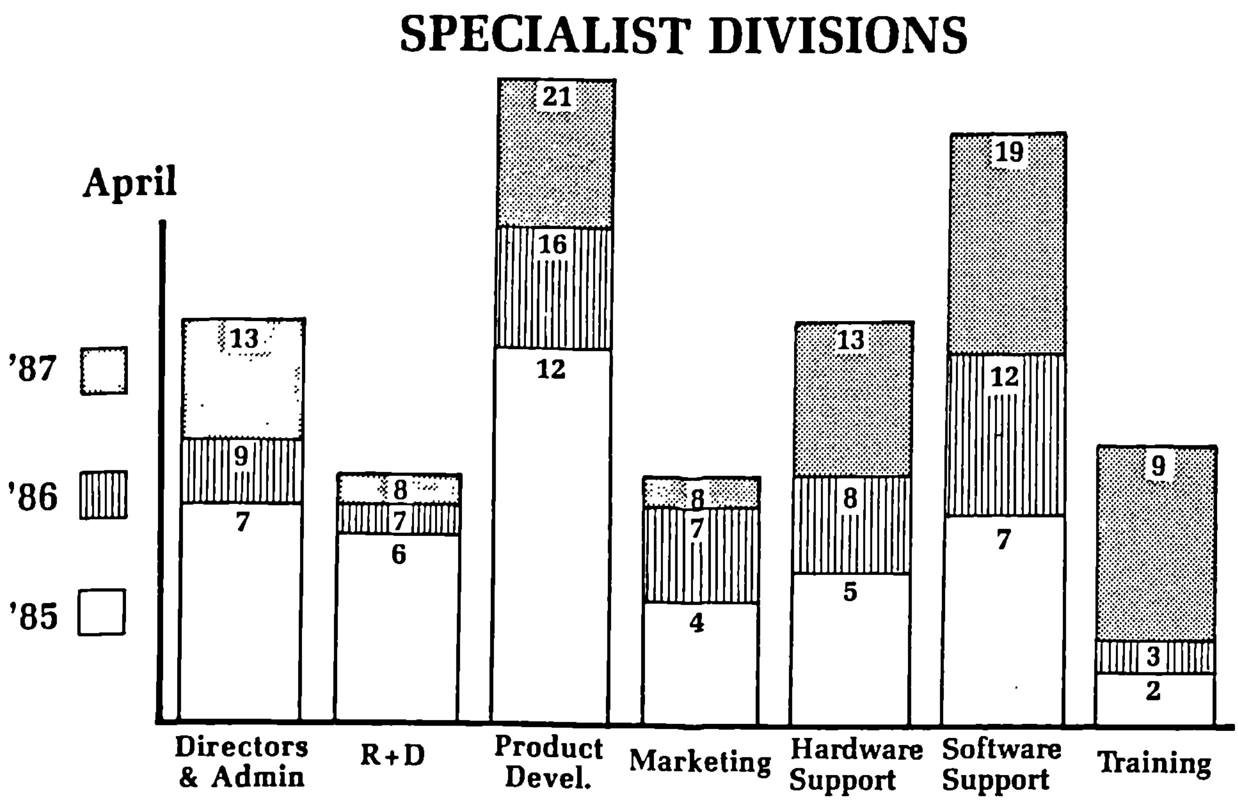
GROWTH IN COMPUTER GROUP PERSONNEL



(Source: figures provided by managing director)

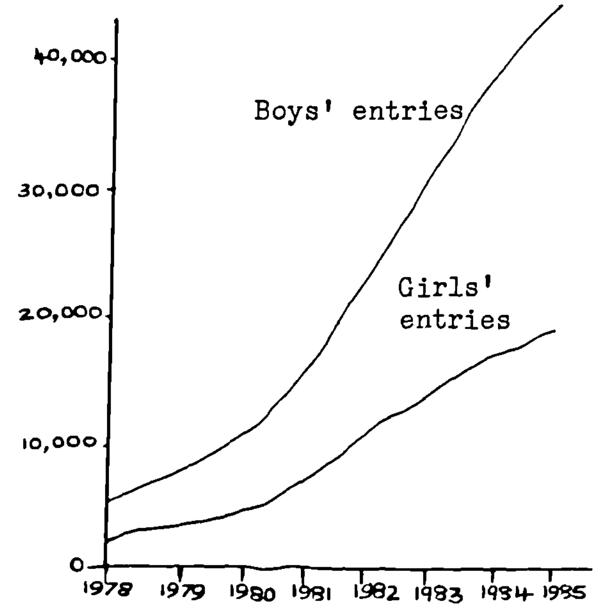
CASE C: FIGURE 13

COMPANY STRUCTURE

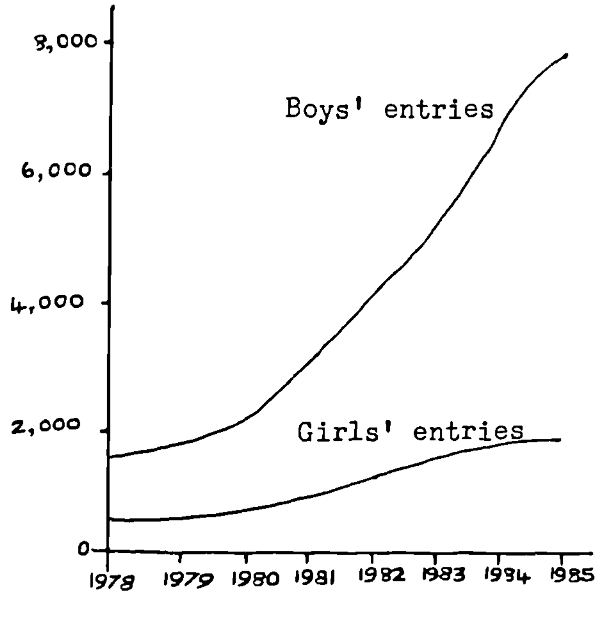


(Source: figures provided by Managing Director)

FIGURE 14: THE GAP BETWEEN MALE AND FEMALE ENTRIES FOR 'O' AND 'A' LEVEL COMPUTING COURSES: 1978-1985



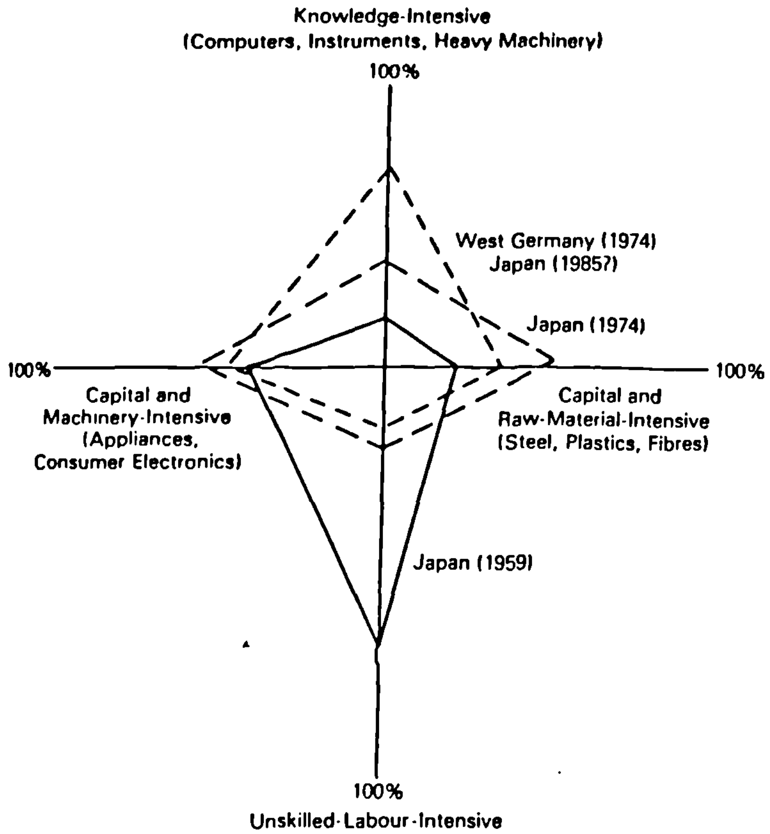
'O' level computer studies



'A' level computer studies

(Source: DES Statistics of Education: School-leavers CSE & GCE)

Figure 15: Changes in Industrial Structure



(Source: Rothwell and Zegveld (1985), page 149)

APPENDIX 1: ASSOCIATIONS AND ORGANISATIONS CONTACTED INITIALLY

1. Association of Professional Computer Consultants, 109 Baker Street, London W1M 2BH.

2. Association of Viewdata Information Providers Ltd., 102-108 Clerkenwell Road, London EC1M 5SA.

3. British Computer Society (BCS), 13 Mansfield Street, London W1M OBP.

4. British Electrical and Applied Manufacturers Association Ltd., 8 Leicester Street, London WC2H 7BW.

5. Computer Arts Society, 50-51 Russell Square, London WC1B 4JX.

6. Computer Services Industry Training Council (COSIT), Victoria House, Vernon Place, London WC1.

7. Engineering Industry Training Board, 54 Clarendon Road, Watford, Herts, WD1 1LB.

8. Information Technology Skills Agency (ITSA), Centre Point, 103 New Oxford Street, London WC1A 1DU.

9. Institute of Data Processing Management, 50 Goschen Buildings, 12-13 Henrietta Street, London WC2E 8NU.

10. Institute of Manpower Studies, Mantell Building, University of Sussex, Falmer, Brighton BN1 9RF.

11. Institute of Personnel Management, IMP House, Camp Road, London SW19 4UW.

12. Local Authorities Management Services and Computer Committee, 3, Buckingham Gate, London SW1E 6JH.

13. National Computing Centre, Oxford Road, Manchester M1 7ED.

14. Peripheral Suppliers Association, Owles Hall, Buntingford, Herts.

15. Society for Computers and Law, 11 High Street, Milton, Abingdon, Oxon OX14 4ER.

16. U.K. Information Technology Organisation, 15, Rodenhurst Road, London SW4 8AE.

APPENDIX 2A: LIST OF QUESTIONS USED IN THE ELECTRONIC SURVEY OF SCHOOLS

1. THE SCHOOL ITSELF

(a) Name of school

(b) Number of pupils on roll this year
next year

(c) Age range of pupils

(d) Number of teachers employed

(e) Number of periods in the school week

(f) If you are a TVEI School, how many pupils are involved in TVEI courses? Girls Boys

2. IT RESOURCES

(i) Hardware

(a) Number and type of computers in school

(b) Please give details of any networks

(c) How are your computers distributed around the school?

(d) Brief details of all peripherals (screens, disc drives, printers etc.)

(e) Help from non-teaching assistants. Please outline assistance given to teachers who use computers in their lessons by:

Technicians Secretaries Pupils Others (please specify)

3. THE SCHOOL APPROACH TO IT IN THE CURRICULUM

Please complete the following tables as fully as possible:

TABLE 1

Examination courses with an ESSENTIAL computer component, e.g. computer science, computer studies, information technology, business technology etc.

Subject	Year	Class	Exam	Staff	Pupils	Periods per school year

TABLE 2

Non-examination courses with an ESSENTIAL computer component, e.g. computer awareness, information technology etc.

Subject	Year	Class	Staff	Pupils	Periods per school year

3. THE SCHOOL APPROACH TO IT IN THE CURRICULUM (continued)

TABLE 3

Other courses (both examination and non-examination) where computers are used to assist learning (CAL).

Subject	Year	Class	Exam	Staff	Pupils.	Periods per school year

4. OPEN FORUM

If you feel that the above information does not give a true picture of the use of IT in your school, please feel free to enter any further details below.

SCHOOLS SURVEY FORM

1. The school itself

a. Name of school — — — — — — — SCHOOL FOR GIRLS

b. Number of pupils on roll

this year 1055

in 1990 890

c. Age range of pupils 11-18

d. Number of teachers employed

e. Number of periods in the school week 40

f. If you are a TVEI school, how many pupils are involved in TVEI courses?

Girls — Boys —

2. IT RESOURCES

(i) Hardware

a. Number and type of computers in school

13 BBC Model B microcomputers
1 BBC Master ET
1 BBC Master 128
2 Research Machines 380 Z

b. Please give details of any networks

12 STATION ECONET LEVEL 2 SYSTEM

c. How are your computers distributed around the school?

Majority of machines in Computer Laboratory
1 Computer / Printer / Disc Drive / Monitor in Library
1 "mobile" system in SCIENCE department

d. Brief details of all peripherals (screens, disc drives, printers, etc.)

3 Colour monitors
14 Monochrome (green) monitors
2 Double 40/80 track Disc Drives + 1 single 40/80 drive
3 printers (Microline 80; Epson MX80; Walters WM2000)
Mouse
Bar Code Reader
Light Pen
3 "Buggles"

e. Help from non-teaching assistants.

Please outline assistance given to teachers who use computers in their lessons by:

Technicians None

Secretaries None

Pupils Selected pupils operate network, produce back up discs; etc.

Others (please specify)

3. THE SCHOOL APPROACH TO IT IN THE CURRICULUM

Please complete the following tables as fully as possible in line with the example table.

F = female
M = male
Class = Form = Set = Group

EXAMPLE TABLE

Subject	Year	Class	Exam	Staff	Pupils	Periods per school year
Comp.St.	A	1M	160			
Comp.St.	B	1F	160			
Comp.Sc.	*	1F	320			

TABLE 1

Examination courses with an ESSENTIAL computer component, e.g. computer science, computer studies, information technology, business technology, etc.

Subject	Year	Class	Exam	Staff	Pupils	Periods per school year
Computer Studies	4	1	SEG GCSE 5004	1	20	120
Computer Studies	5	1	JMB GCE "O" LEVEL	1	25	120
Computer Studies	6	1	JMB 'A' LEVEL	1	4	210
Computer Studies	7	1	JMB 'A' LEVEL	1	1	240
UCLES Information Technology	6	1	CIT	1	?	120

TABLE 2

Non-examination courses with an ESSENTIAL computer component, e.g. computer awareness, information technology, etc.

Subject	Year	Class	Staff	Pupils	Periods per school year
Information Technology	1	1C	3	approx 30	30 + ?
	1	1J	3	— " —	— " —
	1	1N	3	— " —	— " —
	1	1M	3	— " —	— " —
	1	1W	3	— " —	— " —
Information Technology	2	2D	1	— " —	30 + ?
		2S	1	— " —	— " —
		2W	1	— " —	— " —
		2J	1	— " —	— " —
		2M	1	— " —	— " —

TABLE 3

Other courses (both examination and non-examination) where computers are used to assist learning (CAL).

Subject	Year	Class	Exam	Staff	Pupils	Periods per school year

4. OPEN FORUM

If you feel that the above information does not give a true picture of the use of IT in your school, please feel free to enter any further details below.

Information Technology - Year 1 : All pupils in Year 1 will have one lesson per week working with computer related projects OR keyboard skills. In addition there will be a component of the course carried out in English lessons

Year 2 : Pupils will be withdrawn from lessons on a rota basis to continue computer orientated studies.

University of Cambridge Local Examinations Syndicate : Cambridge Information Technology - Year 6 : Trial period for this course, numbers involved not known at this time.

There is a limited use of computers by Physics, Chemistry, Geography departments for CAL work but insufficient to warrant entries in the Table 3

Thank you for your help with this research project.

J.J. Wellington

APPENDIX 3: LIST OF QUESTIONS USED IN THE POSTAL SURVEY OF ITeCs

I. DETAILS OF THE ITeC ITSELF

1. Please give the name of your centre
2. Who is/are your sponsor(s)
3. When were you established as an ITeC
4. Number of trainees: (a) YTS (b) Others (please specify)
5. Intake policy: How do you select your entrants? (if at all)

II. RESOURCES

1. Staffing:

   Without giving names, please outline the duties, qualifications and experience of your staff.

2. Equipment:

   (a) Please list the number and type of computers, word-processors etc., including details of networks.

   (b) What software do you use?

   (c) What other equipment do you have, e.g. in electronics?

3. Sources of Finance:

   (a) Please state the proportion of self-generated income:
   at present
   in the next two years.

   (b) Please explain briefly how such income is generated
   at present
   in the next two years.

   (c) Does the need to generate income affect the training/curriculum you offer, either positively or negatively?

III. CURRICULUM OFFERED

1. Please outline the broad areas you cover in your training, e.g. computing, electronics, office automation, life skills, etc. Within each area please give brief details.

2. Placements with employers

   (a) How do you plan to arrange the pattern and extent of placement in the new two-year YTS?

2. Placements with employers (continued)

   (b) Please state any difficulty in finding placements
   now
   in new two-year courses

   (c) What proportion of your placements involve trainees in work directly related to I.T.?

   (d) Please give examples of the type of work your trainees typically experience.

IV. ASSESSMENT AND CERTIFICATION

1. Do your trainees follow any recognised courses?
   If so, please specify.

   If not, what are your future plans for courses?

2. What other methods do you use to assess your trainees?

V. DESTINATION OF TRAINEES

1. What systems do you have, if any, of recording the destinations of your trainees?

2. As far as you know, what proportion of trainees go on to:

   (a) employment directly related to I.T.?

   (b) employment, not related to I.T.?

   (c) further education?

   (d) unemployment or other?

VI. PRESENT AIMS AND FUTURE PLANS: OPEN FORUM:

1. How would you describe the main aims and purposes of your centre?

2. How do you plan to adapt your curriculum to the new two-year YTS?

APPENDIX 4: EMPLOYERS' INTERVIEW SCHEDULE

1. THE COMPANY OR DIVISION OF COMPANY

Products
Customers
Numbers of employees
If IT "producer", number of employees not directly involved with IT
If IT "user", number of employees who regularly use IT equipment
Use of IT equipment
  in which departments
  at what levels.

2. LEVELS OF RECRUITMENT

General recruitment (quantify for 1986)

(a) graduate or above
(b) HNC/HND etc.
(c) school leavers 18+
(d) school leavers 16+
(e) YTS trainees
(f) YTS finishers

IT recruitment from categories (a) to (f) above, e.g. computer programmers, operators, "software/systems engineers", word-processors.

3. SELECTION PROCEDURES

A. CHANNELS for (a) to (f).

B. CRITERIA FOR (a) to (f).

specific skills
general skills
the "right attitudes"
certain (personal) qualities
other factors e.g. personal appearance, speech etc. (discuss).

4. PRIOR IT SKILLS REQUIRED BY COMPANY FOR (a) to (f)

A. General IT experience ...

word-processing
use of a database/data retrieval
spreadsheets
viewdata systems
programming
graphics
control systems

B. Specific IT skills, e.g. programming in specific languages, experience of particular packages.

C. Training of employees (in-house or elsewhere).

5. SUPPLY SHORTAGES IN (a) to (f)?

If yes ... where?
why?

If no ... are you therefore happy with the quality/quantity of the output of the education system?

6. NEEDS OF EMPLOYERS IN RELATION TO EDUCATION/TRAINING

Discussion: do you feel that the requirements of employers are met by present provision in education/training?

7. THE FUTURE

Company's future
general
IT

Britain's future.

APPENDIX 5: EXPLORATORY INTERVIEWS: COMPANIES INVOLVED
(in alphabetical order)

Representatives from the following firms were interviewed:

British Aerospace

British Steel Corporation

Electronic Data Systems

GEC

ICL

ITT Europe Engineering Support Centre

K3 Software Services

Phillips Electronics

RACAL Electronics

Research Machines Ltd.

Rolls Royce

Sainsbury

STC

Texas Instruments

1. Your Company or Organisation

a) Could you please name the company/organisation to which your replies relate and the nature of its business (e.g. product, service, etc.)?

____

b) How many employees are there in your company/organisation?

____

c) Does your company/organisation use Information Technology in any way?

YES NO

If YES could you briefly describe those uses?

For the purposes of this questionnaire, levels of recruitment have been divided into five separate categories:

a) graduate level and above
b) further education, e.g. HNC/HND, B/TEC, etc.
c) school leavers at 18plus
d) school leavers at 16plus
e) YTS trainees

Please answer the questions in Sections 2, 3 and 4 for each of these categories (where relevant to your company)

---

2. Recruitment Policy

a) In a typical year, approximately how many new employees are recruited from categories a to e?

a ______ b ______ c ______ d ______ e ______

b) Approximately how many of these employees are recruited into jobs which involve using Information Technology? (e.g. database, word-processing, programming, etc.)

a ______ b ______ c ______ d ______ e ______

c) What jobs in relation to IT (if any) would recruits in these categories perform?

a ______________________________

b ______________________________

c ______________________________

d ______________________________

e ______________________________

3. Prior Requirements

a) What general criteria do you use in selecting your recruits from each of these categories? (e.g. specific skil attitudes, appearance, education, etc.)

a ____

b ____

c ____

d ____

e ____

b) What skills/abilities/knowledge/education in IT (if any) do you require of your recruits prior to entry at each lev

a ____

b ____

c ____

d ____

e ____

4. Supply Shortages

a) Are there any jobs within your company related to IT which you have found difficult to fill? Please specif

b) At which levels (if any) do these shortages occur?

c) What changes do you foresee in staffing requirements in relation to IT over the next 5 years?

5. Your views of the Education and Training Systems: Open Forum

a) Do you feel that the education and training systems are providing your company with the necessary "work-force" in IT?

b) If not, at which level is there a supply problem?

c) Can you suggest ways of improving the quality or quantity of the supply?

d) Please discuss your views of the products of the education and training system at all levels, using a separate sheet if necessary.

6. If you would be willing to discuss this area further in a short interview, could you please give us a name to contact.

____

THANK YOU VERY MUCH INDEED FOR YOUR CO-OPERATION

1. Your Company or Organisation SINGER LINK-MILES LTD :—

a) Could you please name the company/organisation to which your replies relate and the nature of its business (e.g. product, service, etc.)?

SIMULATION SYSTEMS – AIRCRAFT / MARITIME / VEHICLES / COMPUTER GENERATED IMAGERY

b) How many employees are there in your company/organisation?

CIRCA 1400.

c) Does your company/organisation use Information Technology in any way?

YES ✓ NO

If YES could you briefly describe those uses?

COMPUTERS THE KEY TOOL TO 'SIMULATION'; IT IS THEREFORE FOUND IN ALL FORMS THROUGHOUT THE COMPANY – EG. SYSTEMS ENGINEERING – MINI & MICRO-COMPUTERS FOR DESIGN, R&D MULTI-MICROPROCESSORS, PRODUCT DESIGN – CAE & CAD, DATA-PROCESSING – IBM MAINFRAME, SECRETARIAL – WORD PROCESSORS / INTELLIGENT TYPEWRITERS. MANAGEMENT – IBM 'PC'S ON & OFF-LINE ETC. ETC. !!

For the purposes of this questionnaire, levels of recruitment have been divided into five separate categories:

a) graduate level and above
b) further education, e.g. HNC/HND, B/TEC, etc.
c) school leavers at 18plus
d) school leavers at 16plus
e) YTS trainees

Please answer the questions in Sections 2, 3 and 4 for each of these categories (where relevant to your company)

2. Recruitment Policy

a) In a typical year, approximately how many new employees are recruited from categories a to e?

a 70 b 50 c 6-10 d 6-10 e 10

b) Approximately how many of these employees are recruited into jobs which involve using Information Technology? (e.g. database, word-processing, programming, etc.)

a ____ b ____ c ____ d ____ e ____ } ALL OF THEM !!

c) What jobs in relation to IT (if any) would recruits in these categories perform?

a SYSTEMS ENGINEERS / SOFTWARE ENGINEERS / R&D ENGINEERS

b MECHANICAL / ELECTRICAL / PCB DESIGNERS / TEST & INTEGRATION ENGINEERS / BUSINESS ADMIN + R

c, d } 'TRAINING' POSITIONS FOR ALL THE ABOVE CATEGORIES + SECRETARIAL / CLERKS DATA BASE MODELLERS

e AS WITH C&D – STARTING AT A LOWER LEVEL BUT ENCOURAGED TO AIM FOR HIGH LEVEL POSITIONS VIA DAY RELEASE.

3. Prior Requirements

a) What general criteria do you use in selecting your recruits from each of these categories? (e.g. specific skills, attitudes, appearance, education, etc.)

a (1) SPECIFIC SKILLS 'TO DO THE JOB' (2) POSITIVE TEAM ATTITUDE/COMMITMENT & 'REALISM'.

b AS ABOVE

c MOTIVATION / WILLINGNESS TO LEARN & TO BE COMMITTED / STABILITY.

d ATTITUDE & DRIVE

e AS ABOVE

b) What skills/abilities/knowledge/education in IT (if any) do you require of your recruits prior to entry at each level?

a QUALIFICATIONS MUST BE IN APPROPRIATE AREA WITH EXPERIENCE OF IT.

b AS ABOVE.

c GENERALLY 'A' LEVEL QUALIFIED PREFERABLY WITH COMPUTING/ELECTRONICS ALTERNATIVELY MATHS/PH

d } MINIMAL, EXCEPT FOR A KEEN INTEREST WITHIN HIGH TECHNOLOGY

e } UTILISING I.T.

4. Supply Shortages

a) Are there any jobs within your company related to IT which you have found difficult to fill? Please specify:

R & D ENGINEERS
SOFTWARE ENGINEERS
SYSTEMS ENGINEERS
ELECTRICAL ENGINEERS
PCB DESIGNERS

b) At which levels (if any) do these shortages occur?

HNC LEVEL UPWARDS. LEVEL MAY NOT ALWAYS BE APPROPRIATE MEASURE AGAINST AN ISOLATED 'EDUCATIONAL QUALIFICATION BENCHMARK'; SHORTAGES OCCUR ALSO RELATIVE TO THOSE WITH 'EXPERIENCE' IN A LIKE JOB

c What changes do you foresee in staffing requirements in relation to IT over the next 5 years?

RE ORIENTATION OF THE INDUSTRY TO RESOURCING AS OPPOSSED TO RECRUITMENT. DEMAND WILL CONTINUE TO OUTSTRIP SUPPLY – TECHNOLOGY WILL CONTINUE TO DEVELOP FASTER THAN EDUCTION & ASSOCIATED QUALIFICATIONS. RESULTS WILL BE GREATER FLEXIBILITY IN ENTRY POINTS TO INDUSTRY FOR JOBS PREVIOUSLY 'GRADUATE ONLY & MORE EMPHASIS UPON DISTANCE LEARNING MATERIAL TO ENSURE EMPLOYEES MOVE WITH IT DEVELOPMENTS.

5. Your views of the Education and Training Systems: Open Forum

a) Do you feel that the education and training systems are providing your company with the necessary "work-force" in IT?

AT GRADUATE LEVEL – A QUALIFIED YES, HOWEVER DUE TO SUPPLY / DEMAND BUSINESS MAY BE RESTRICTED.

VERY FEW COURSES / TRAINING SYSTEMS EXIST BELOW GRADUATE LEVEL WITH APPROPIATE IT CONTENT FOR PRODUCT DESIGN EG CAD; FOR WORDPROCESSING; FOR SYSTEMS / R&D ENGINEERS FOR SOFTWARE ENGINEERS (EXCEPTING RECENT BRIGHTON TECHNOLOGY COURSE IN SOFTWARE ENGINEERING)

b) If not, at which level is there a supply problem?

AS ABOVE.

c) Can you suggest ways of improving the quality or quantity of the supply?

LESS 'FORMAL' ENTRY POINTS TO COURSES – OPEN UNIVERSITY APPROACH.

LESS EMPHASIS UPON THE 'STUDENT' GETTING CLOSER TO INDUSTRY & MORE EMPHASIS UPON THE 'EDUCATOR' TO FIND OUT THE APPLICIBILTY (sic) OF THE TEACHING!!

OBVIOUSLY GREATER INVESTMENT IN IT – WITHIN EDUCATION (DROP A FEW 'DEAD LANGUAGE COURSES FROM OXBRIDGE!!)

d) Please discuss your views of the products of the education and training system at all levels, using a separate sheet if necessary.

PRODUCTS OF THE SYSTEM GENERALLY GOOD, DEPENDING UPON THE PARTICULAR SYSTEM / COURSE. A NUMBER OF COURSES DO HOWEVER REQUIRE GREATER ORIENTATION TOWARDS AN END ROLE. DUE TO THE COMPLEXITY AND MULTI-DISCIPLINED NATURE OF MODERN ENGINEERING GREATER EMPHASIS MUST BE PLACED UPON THE ESSENTIAL SOCIAL SKILLS OF TEAMWORK / COMMUNICATION / PRESENTATION OF KNOWLEGE / INFORMATION.

FORMAL TRAINING SHOULD BECOME MORE 'OPEN' IN THOSE CONSIDERED ABLE ENOUGH TO DEVELOP THE APPROPIATE SKILLS. I ENVISAGE GREATER EMPHASIS IN TEACHING METHODS TOWARDS DISTANCE & OR VIDEO BASED INSTRUCTION.

6. If you would be willing to discuss this area further in a short interview, could you please give us a name to contact.

KEITH ARCHER / PERSONNEL MANAGER : 0903 755881 EXT 212.

THANK YOU VERY MUCH INDEED FOR YOUR CO-OPERATION

34 L

APPENDIX 7: SAMPLING EMPLOYERS FOR THE POSTAL QUESTIONNAIRE

1. DIVERSITY OF ECONOMIC ACTIVITY

The target was to send questionnaires to 1000 employers. In selecting employers account was taken of the number of employees in each area of activity. Using the Department of Employment's Standard Industrial Classification (SIC), an acceptable diversity was achieved by considering the classes within each division. For example, in division 2 there are class 22 (metal manufacturing), class 21/23 (extraction of ores and minerals), class 24 (non-metallic mineral products), and so on.

The number of questionnaires to be sent to employers in any class C was equal to (E/T) x 1000;

where C is the class number

E is the number of employees in class C

and

T is the total number of employees in Britain (20,886,000 in September '85)

2. DIVERSITY OF SIZE

It was decided to ensure that large firms in each class were not under-represented in the random sample by defining small and large firms for each class. This was achieved in the following way. Q is the number where P% of employees in class C work in organisations with Q or less than Q employees. P should be as near to 50 as possible. A small firm in class C is then defined as one that has Q or less than Q employees. A large firm in class C is defined as one that has more than Q employees.

Data in the Business Monitor enabled a calculation of P and Q for a number of classes. For example, it was found that in class 31, 56% of employees work in firms with, or with less than, 200 employees.

Where the Business Monitor does not provide data on the size of organisations in a class it was obtained from two sources:

(1) The Employment Systems, Stats D4, Department of Employment.

(2) Lists of the number of employees in each firm in each class, available through Infoline which accesses Key British Enterprises (KBE).

The number of questionnaires sent to small firms in class C was (((P/100) x E)/T) x 1000

The number of questionnaires sent to large firms in class C was ((((100-P)/100)*E)/T)*1000

2. DIVERSITY OF SIZE (continued)

For example the number of questionnaires sent to small firms in class 31 was

$$(((56/100) \times 382{,}500)/20{,}886{,}000) \times 1000 = 10 \text{ (to the nearest integer)}$$

and the number of questionnaires sent to large firms in class 31 was

$$((((100-56)/100) \times 382{,}500)/20{,}886{,}000) \times 1000 = 8 \text{ (to the nearest integer).}$$

A simple computer program enabled E and P to be input to obtain the desired information quickly.

3. THE SELECTION OF ORGANISATIONS

Having calculated the number of questionnaires to be sent to small and large organisations in each class the next problem was to select the organisations, and then address the questionnaires to them. Three possibilities were considered:

Tw databases were considered at the time. *Both are available either in printed form (as a directory) or as an on-line database. These were Key British Enterprises (KBE) and Inter Company C mparisons (ICC). At the time, KBE was chosen partly because in using this system it was possible tp roduce printed address labels at a reasonable cost. Employers in KBE are selected acc rding to turnover so that the top 20,000 employers in Britain are included.

KBE was accessed using Pergamon Infoline which acts as a "host" system - this was carried out by David Perrow at the Crookesmoor Library, University of Sheffield. In the event two serious drawbacks emerged: Firstly, a number of firms were duplicated or triplicated because they are classified under more than one SIC gr up - these mistakes were rectified before sending out questionnaires. Secondly, KBE does not include the public services, charities, organisations and associations in Division 9. All addresses in Division 9 (almost 300) therefore had to be obtained manually using a variety of printed directories. Addresses were selected to reflect accurately the numbers employed in each of the sub-groups of Division 9 e.g. 9510: Hospitals and nursing homes; 9611: Social work; 9631: Professional and scientific organisations, and so on.

(* KOMPASS On-Line is a third alternative database now available and others will appear in the future.)